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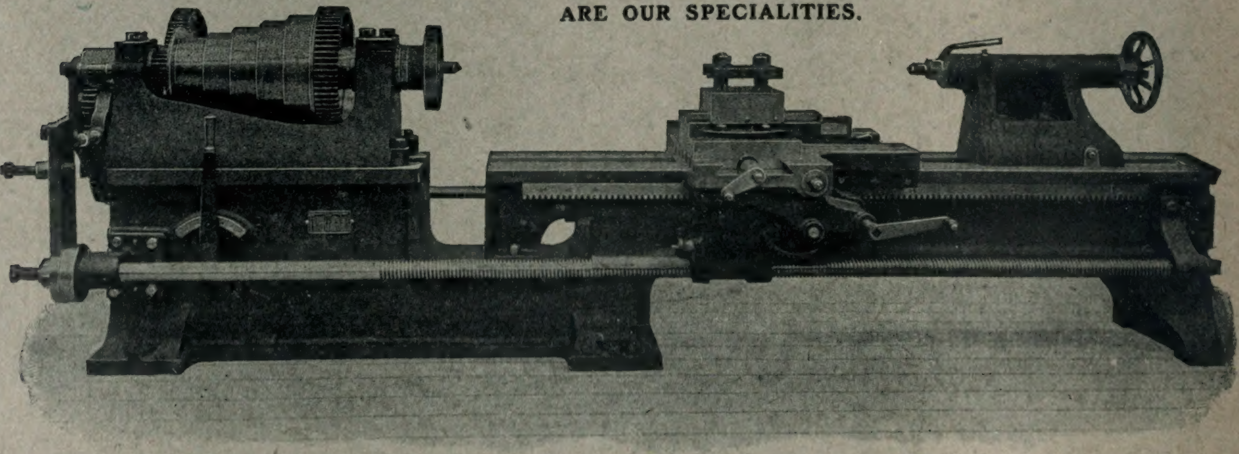

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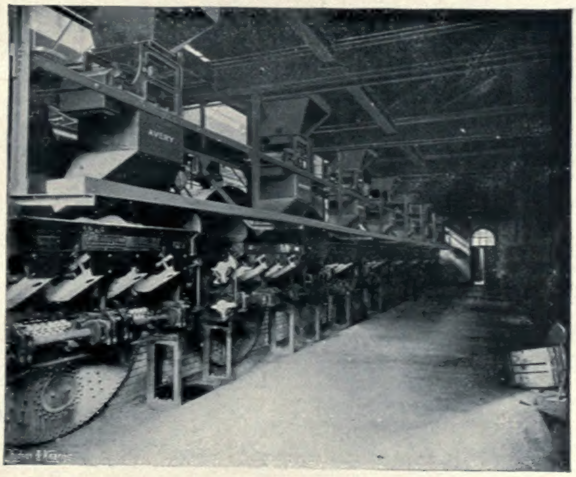

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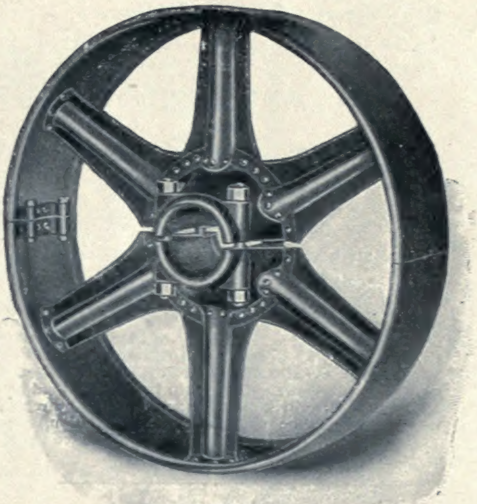

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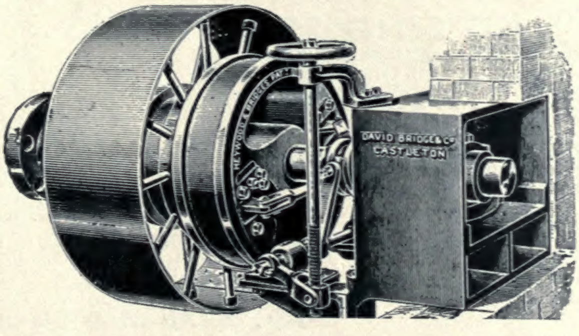

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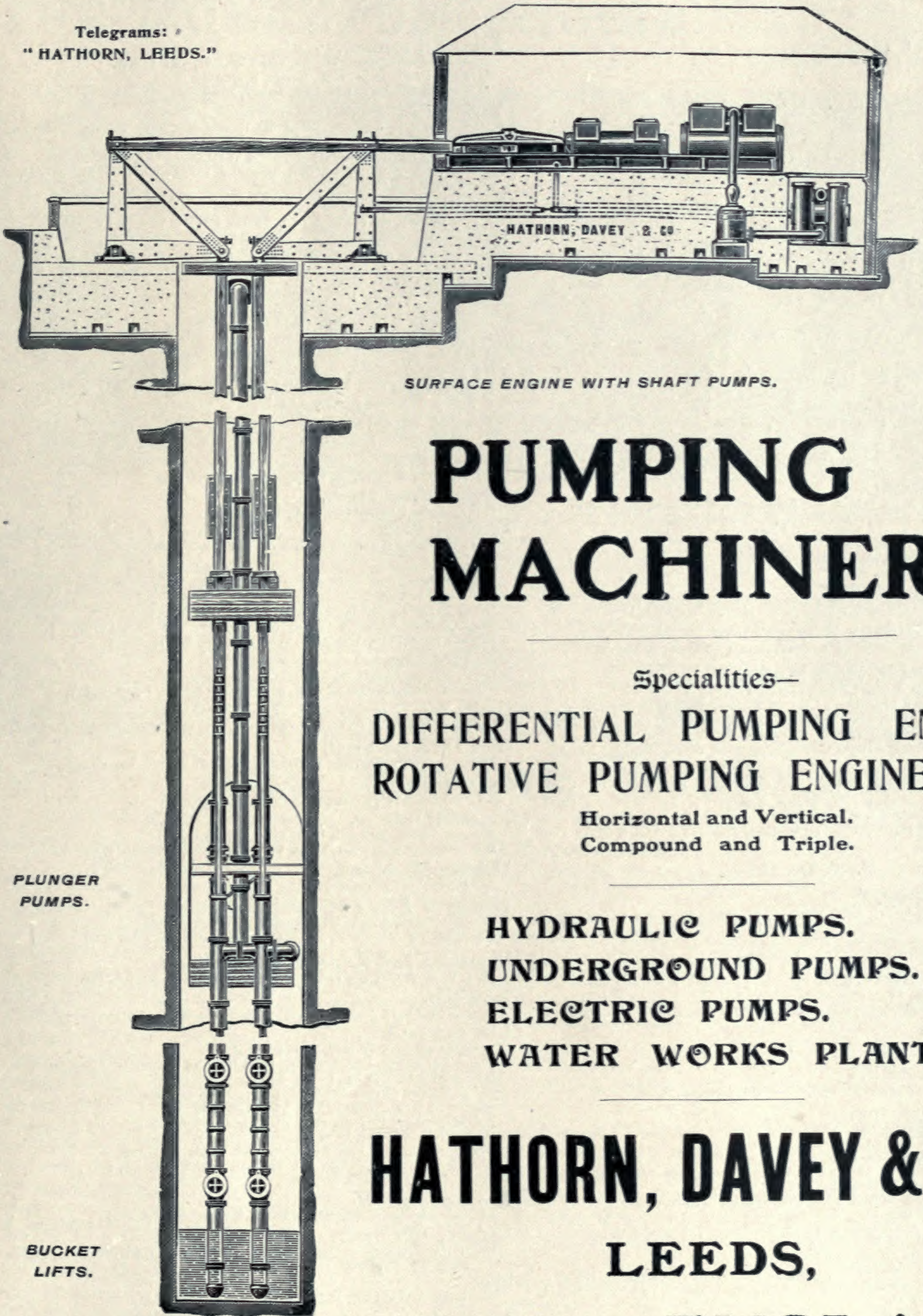

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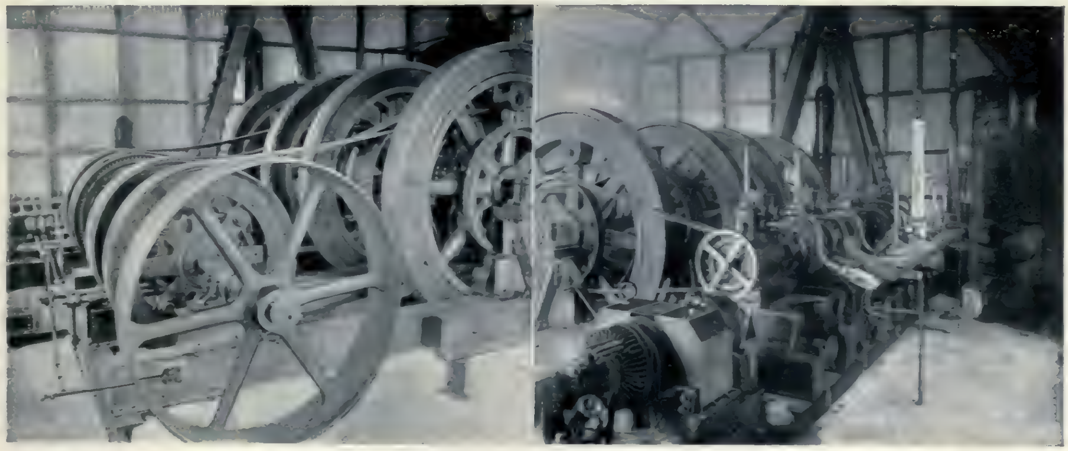

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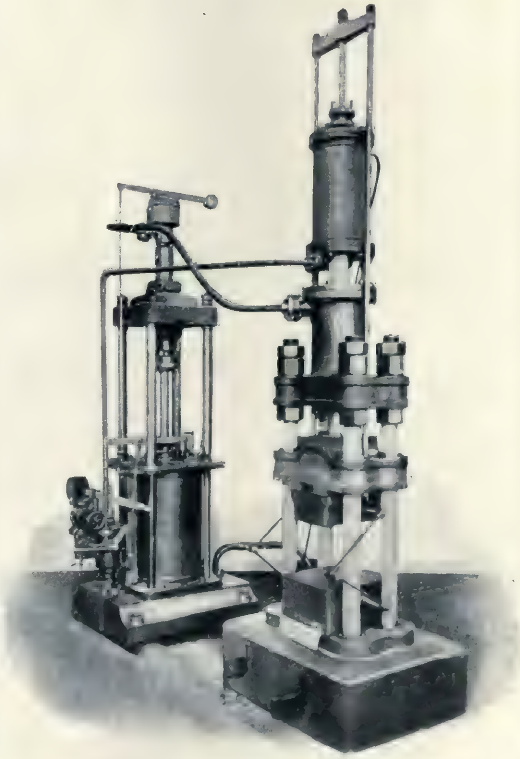

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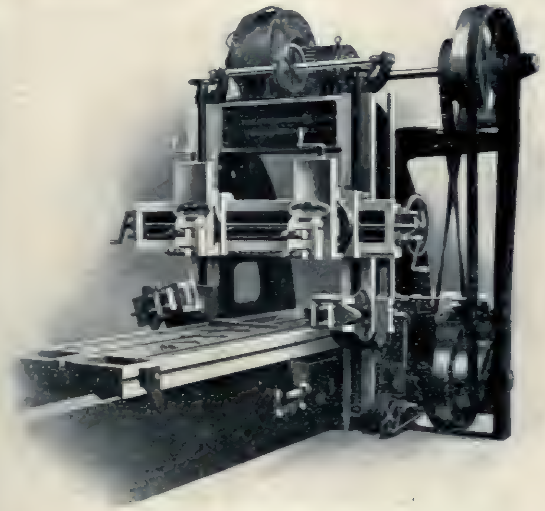

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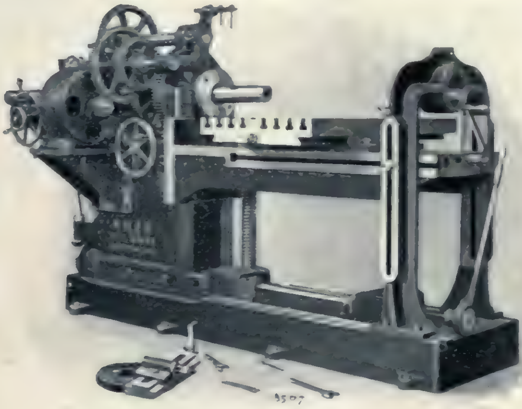

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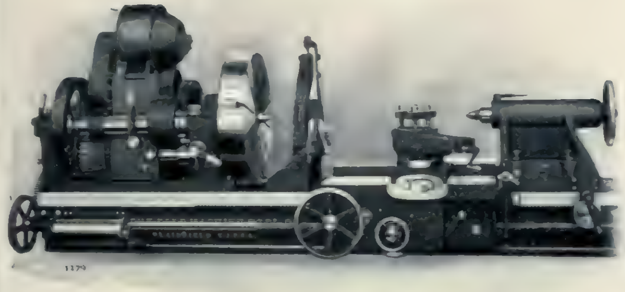

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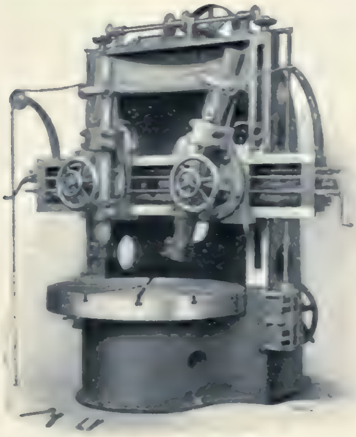

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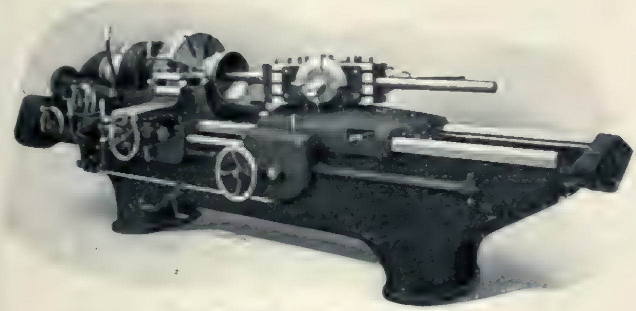

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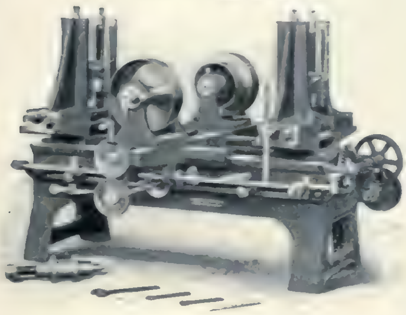

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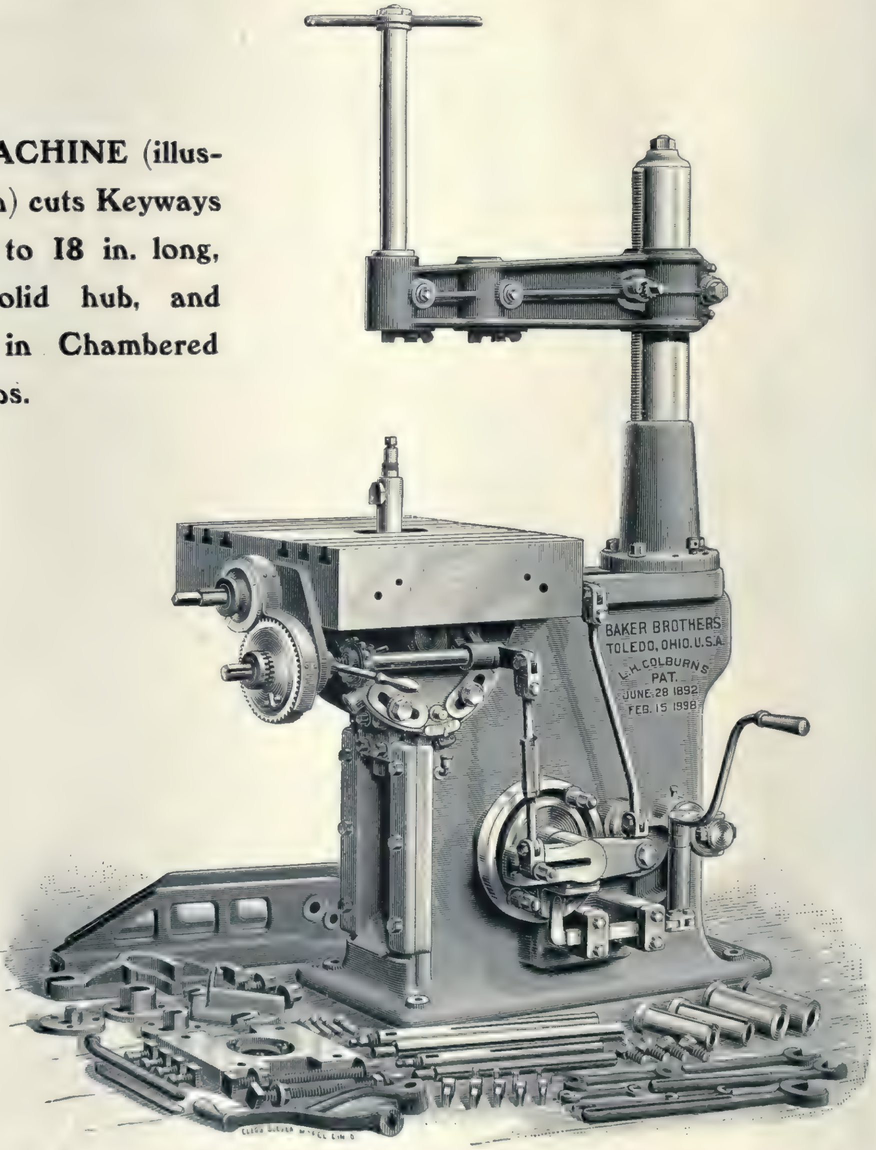

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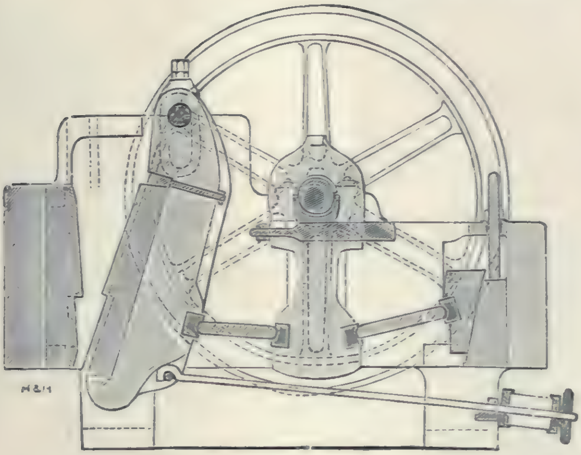

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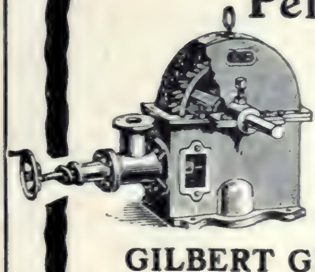

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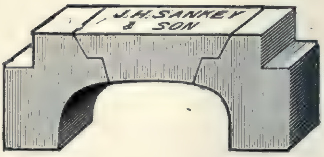

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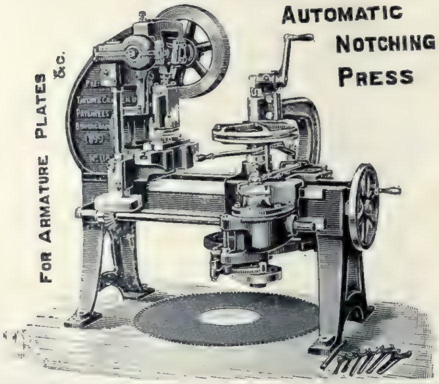

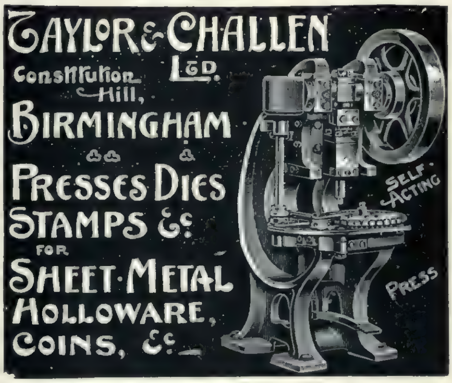

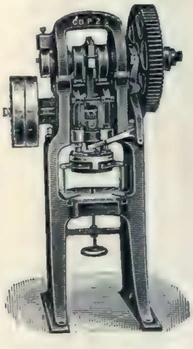

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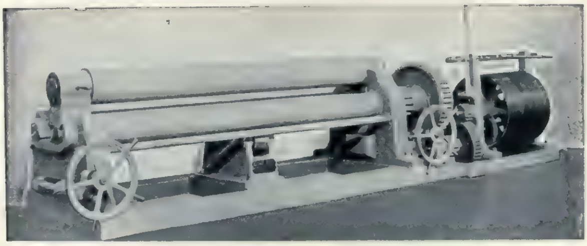

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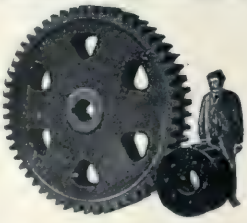

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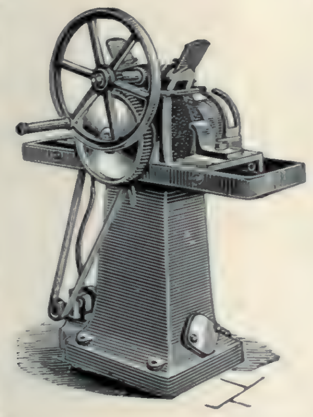

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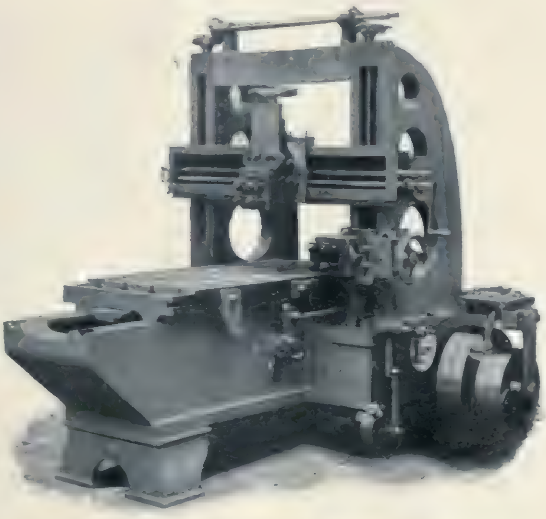

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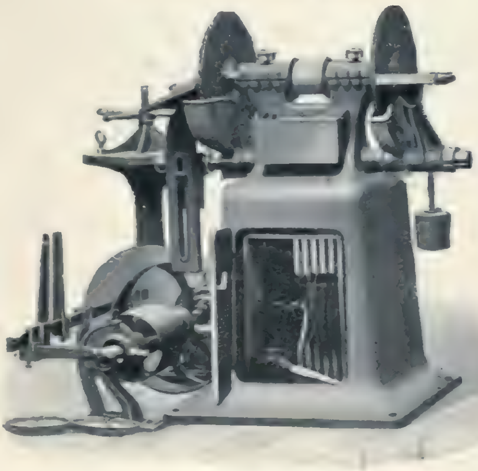

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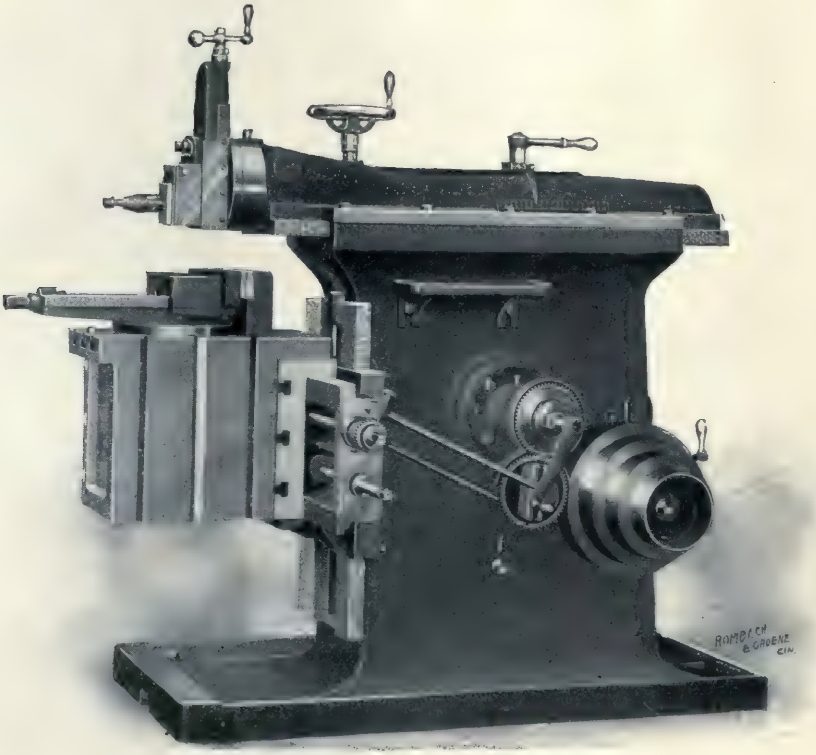

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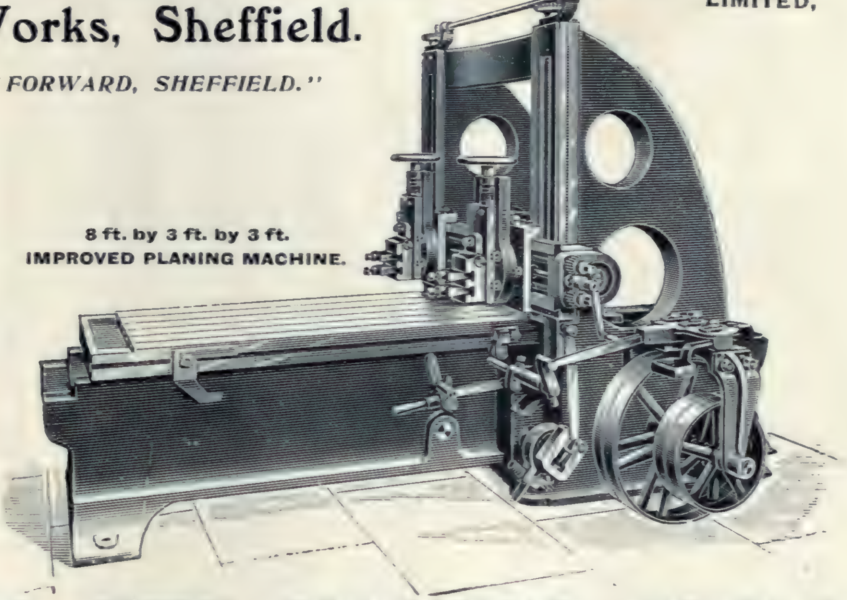

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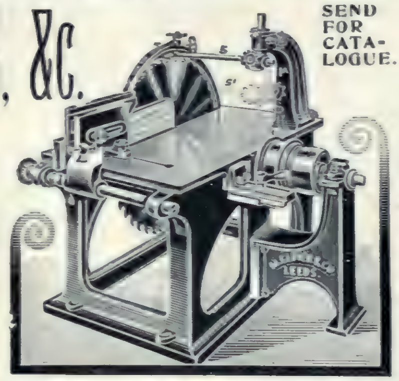

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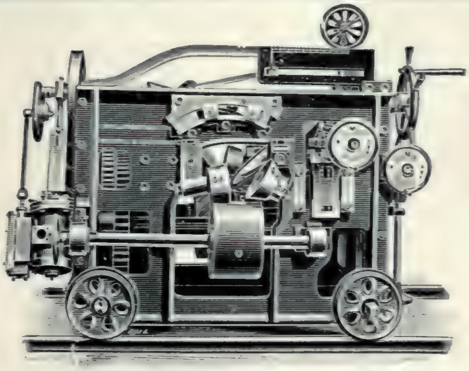

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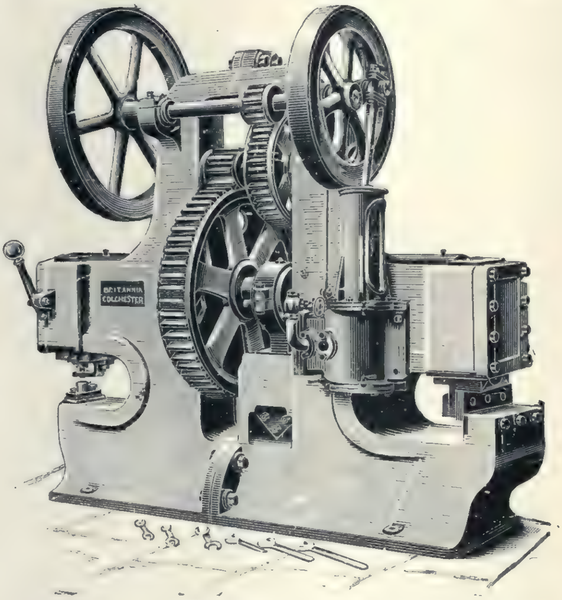

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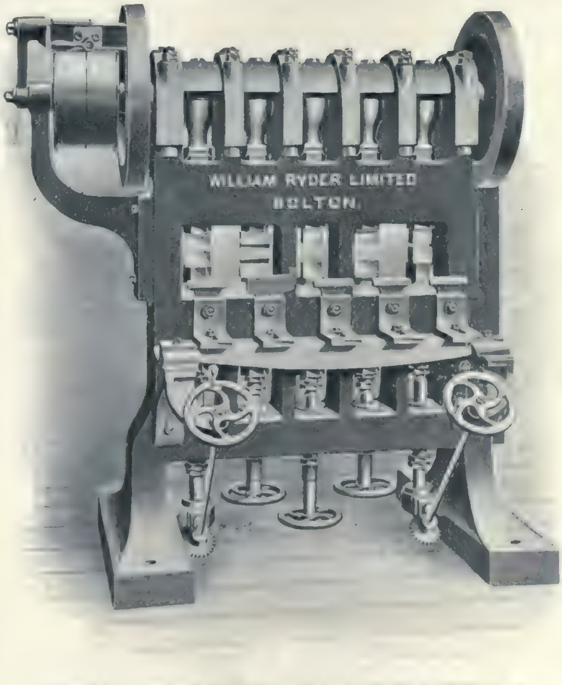

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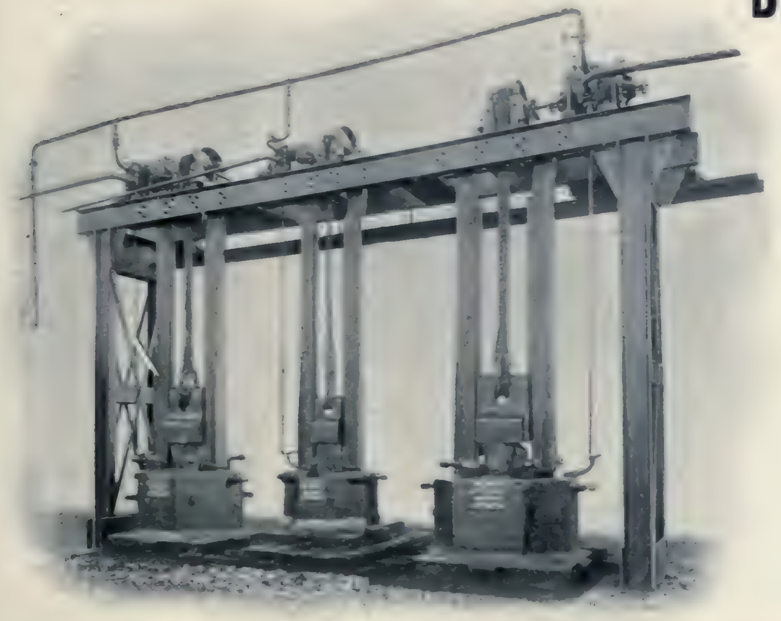

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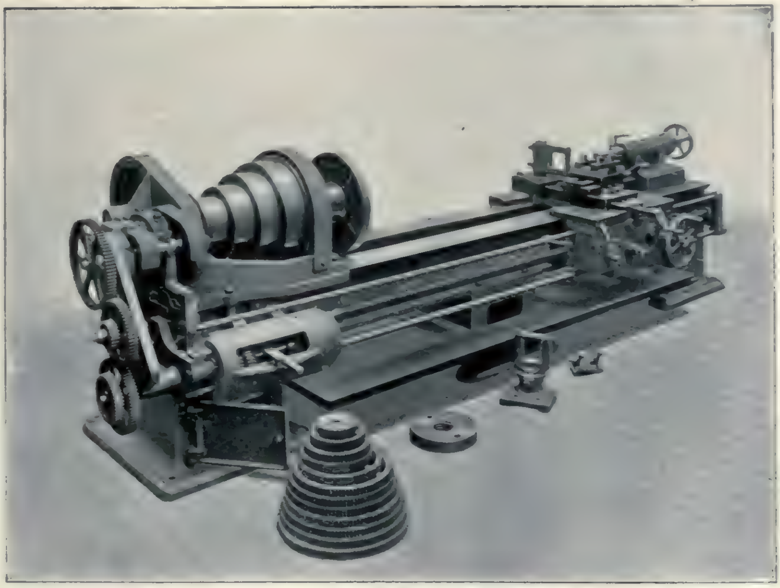

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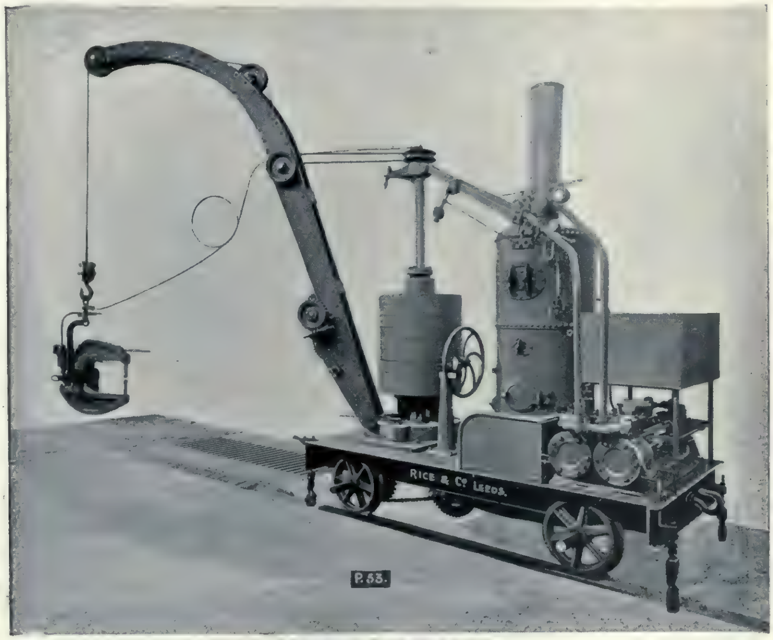

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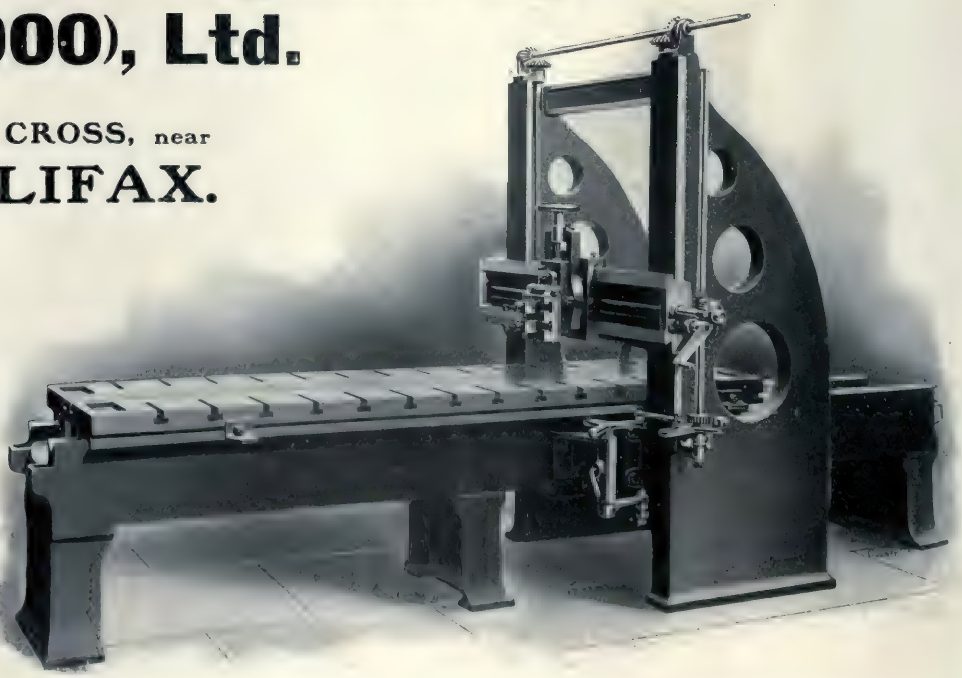

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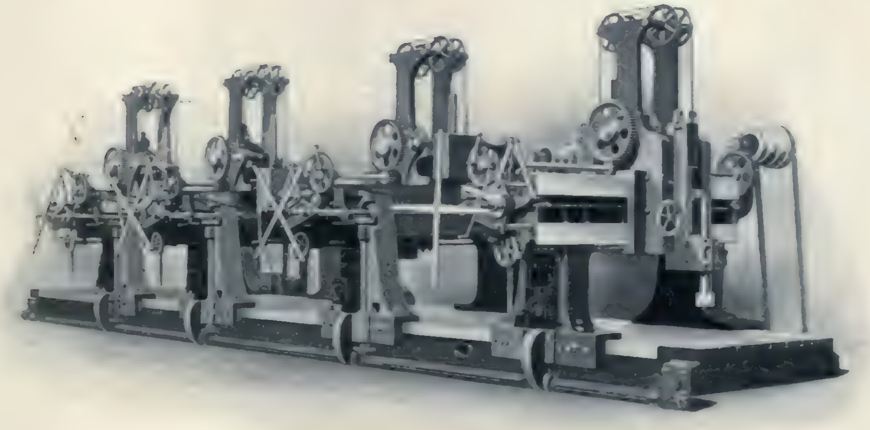

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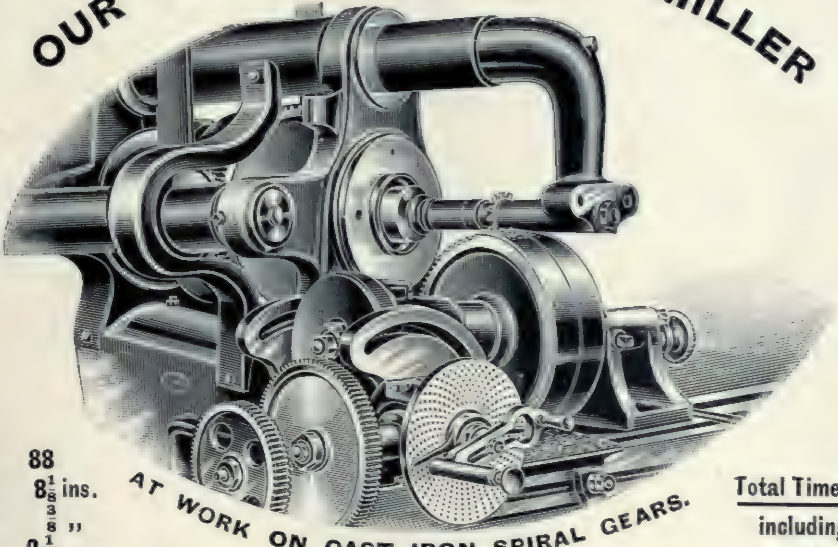

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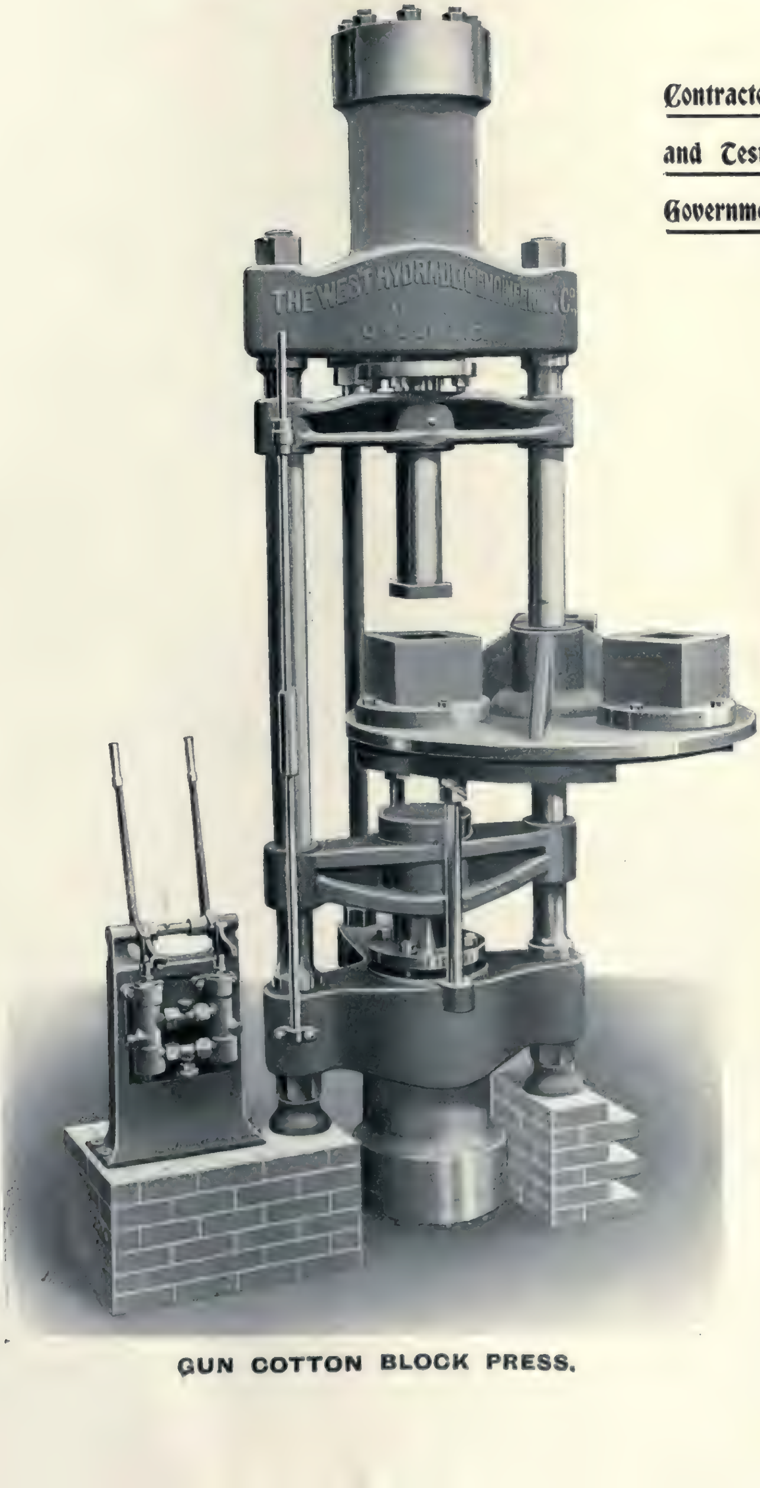

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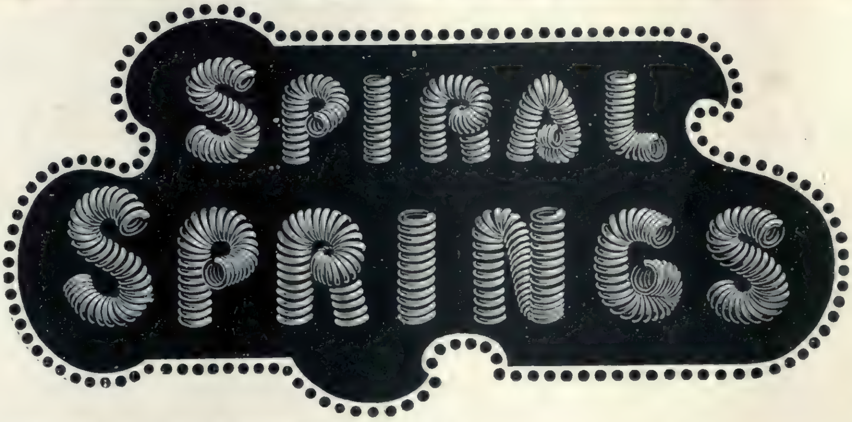

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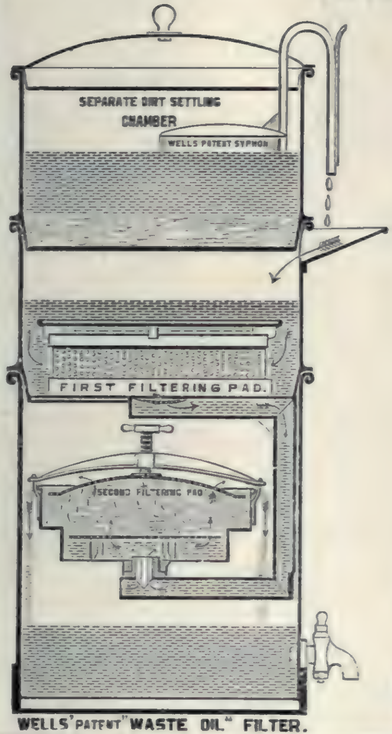

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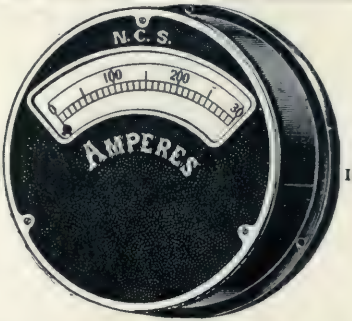

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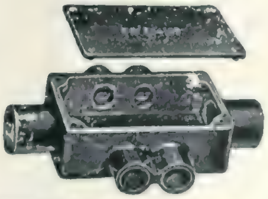

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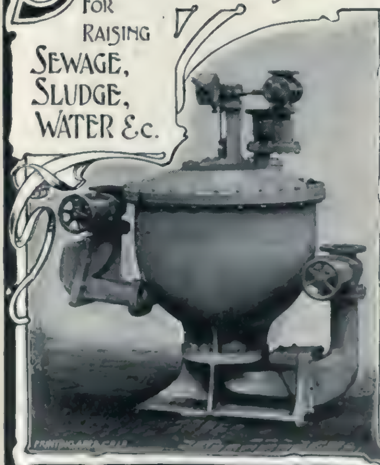

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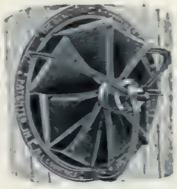

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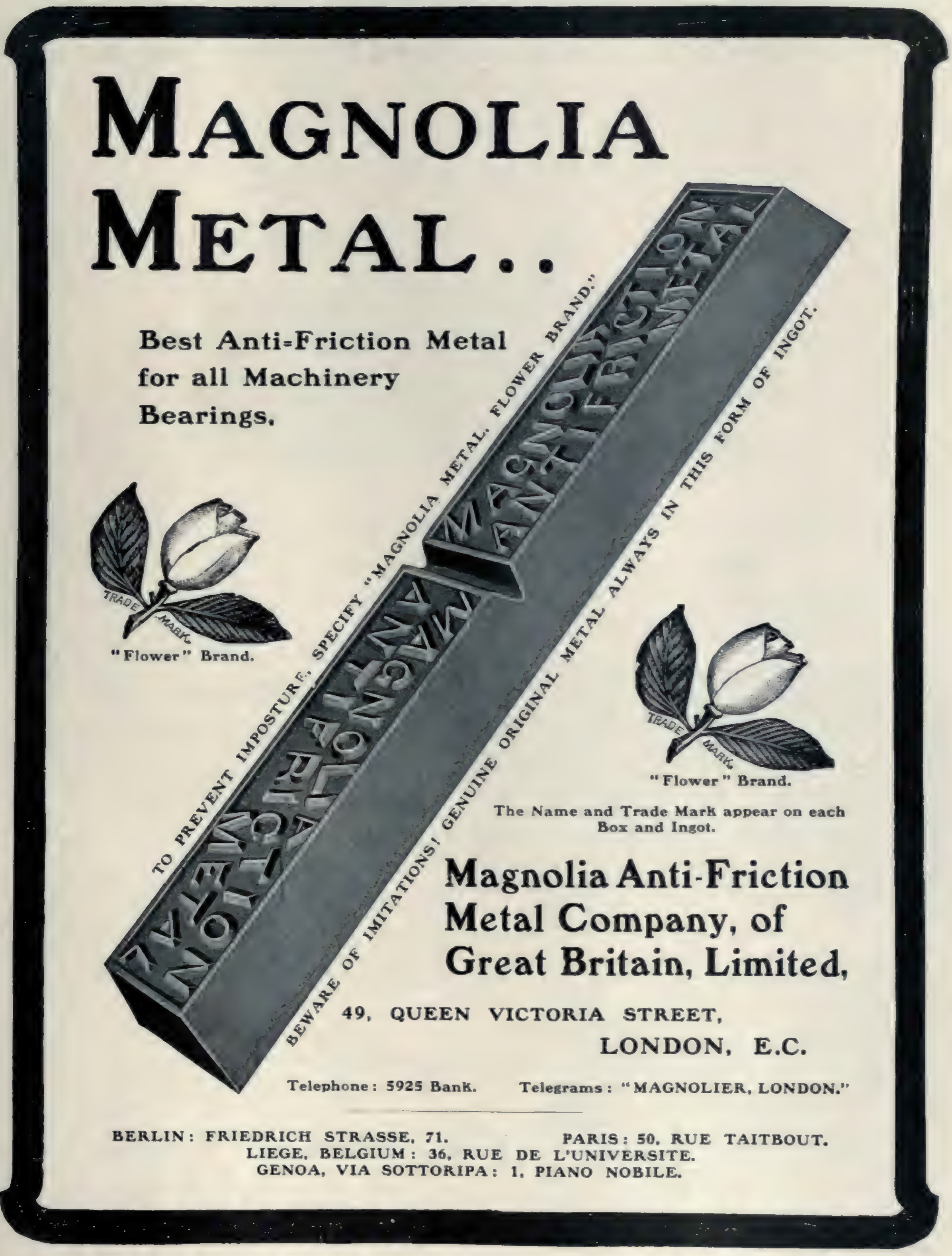

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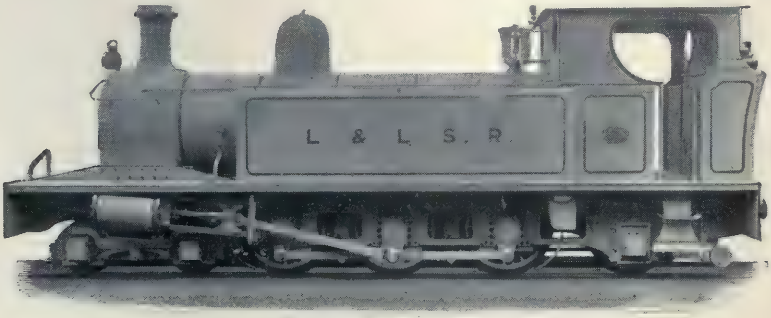

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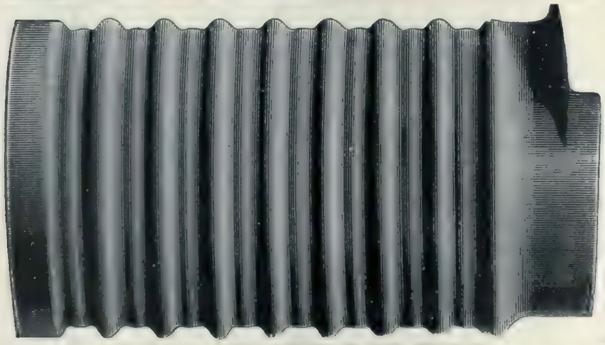

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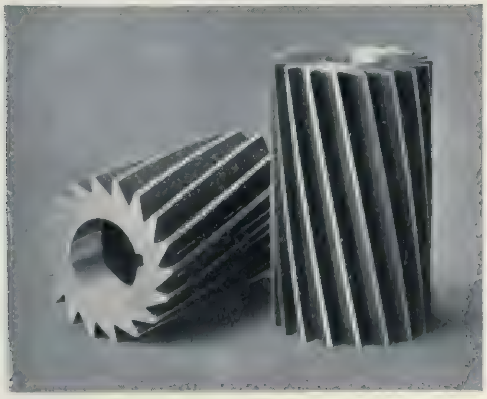

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PAGE'S MAGAZINE

An Illustrated Technical Monthly, dealing with the Engineering, Electrical, Shipbuilding, Iron and Steel, Mining and Allied Industries.

VOL. V. LONDON, OCTOBER, 1904. No. 4.

A NEW DEPARTURE IN TECHNICAL EDUCATION.

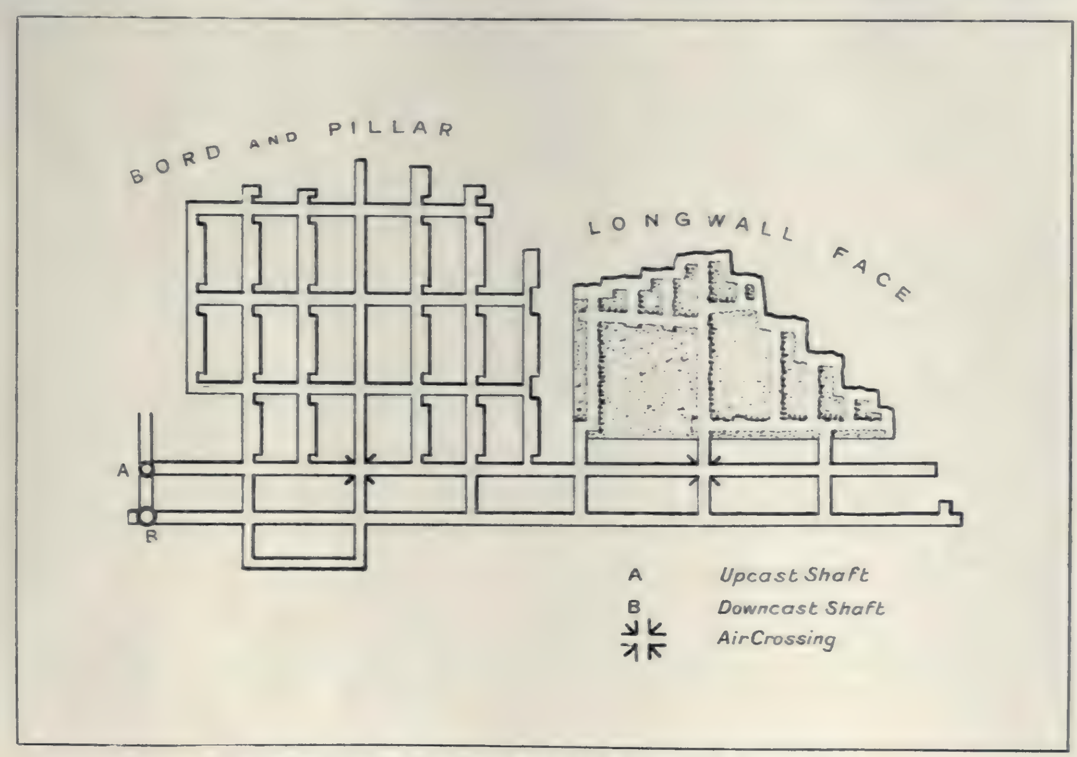
THE EXPERIMENTAL MINE AT BIRMINGHAM UNIVERSITY.

BY

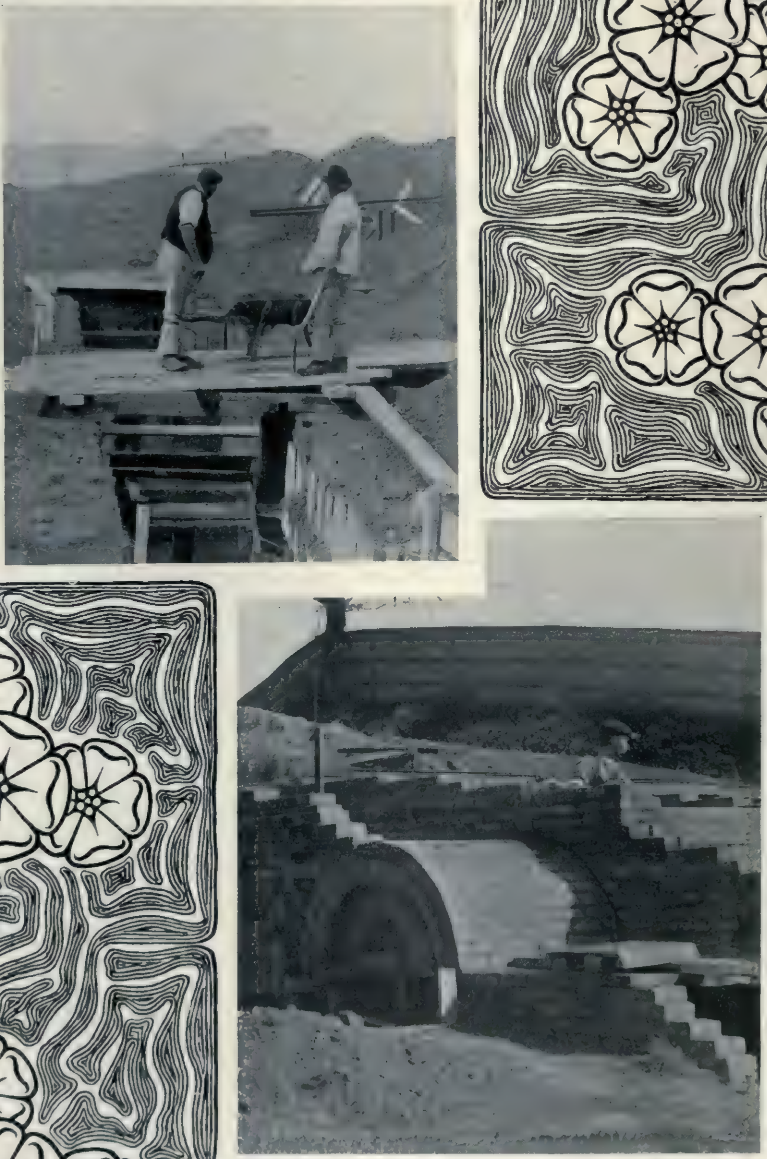
E. H. ROBERTON, B.A., M.Sc.

Mr. Roberton briefly describes one of the most important educational enterprises of modern times, and indicates the directions in which the experimental mine at Birmingham University will aid research.—Ed.

At no university, probably, in the world, is the tendency which makes for the welding of practice with theory more marked than at the University of Birmingham. In every department of applied science large sums of money are being expended by the authorities in rendering the laboratories as perfect and up-to-date as possible in the matter of equipment. But what is probably the most striking feature, especially in view of the fact that the scheme is unique, never before having been attempted in any educational institution,



PLAN OF THE EXPERIMENTAL MINE AT BIRMINGHAM UNIVERSITY.



THE EXPERIMENTAL MINE, IN COURSE OF CONSTRUCTION, AT THE BIRMINGHAM UNIVERSITY.
1. Trenching for Bord and Pillar Workings. 2. View of Air-Crossing.

is the experimental mine. This is situated in the south-east portion of the ground devoted to the new University buildings, taking up an area of nearly an acre, and is now approaching completion.

That such a mine would be of use for experimental research and for the purposes of practical education was an idea that had occupied Professor Redmayne's mind before his accession to the chair of mining at Birmingham, and since his arrival he has lost little time in putting it into practice. For the purposes of simplicity and general utility, as well as owing to the natural configuration of the site, the workings of a coal mine have been chosen as a model for the laying out of the mine. This has the additional commendation that it is largely in coal-mines that latter-day mining problems present themselves—problems of underground transport and winding, of local and general ventilation, of prevention of accidents from explosions of gas and coal-dust, of timbering methods in loose ground and under heavy pressure, and of the laying out of underground workings to the best advantage.

The ground in which the workings are laid out possesses an average gradient of about nine degrees in the direction of the main headways, which gradient will be utilised in the construction of a "self-acting" incline. The material excavated is composed of soft gravel, and the "cut-and-cover" system of tunnelling has been adopted in its construction. Fortunately a great deal of the excavation otherwise necessary has been obviated by the prospective removal of a large quantity of soil from another part of the site, which will be dumped on the site of the mine, and the floor of the mine will ultimately lie at a depth of about 10 ft. from the surface. The original plan of constructing the walls of brick, roofed with a semi-circular brick arch, has been abandoned in favour of having both walls and a flat roof made of concrete, which has the additional advantage of being more easily manipulated to imitate the seam of coal and the stone roof of an actual mine. A good idea of the construction is obtained from the photographs.

A most curious anomaly rendered possible by the construction of this mine is that an "underground" air-crossing, made for the purpose of keeping two currents of air separate, has thus for the first time on record been made visible to the observer in the light of day.

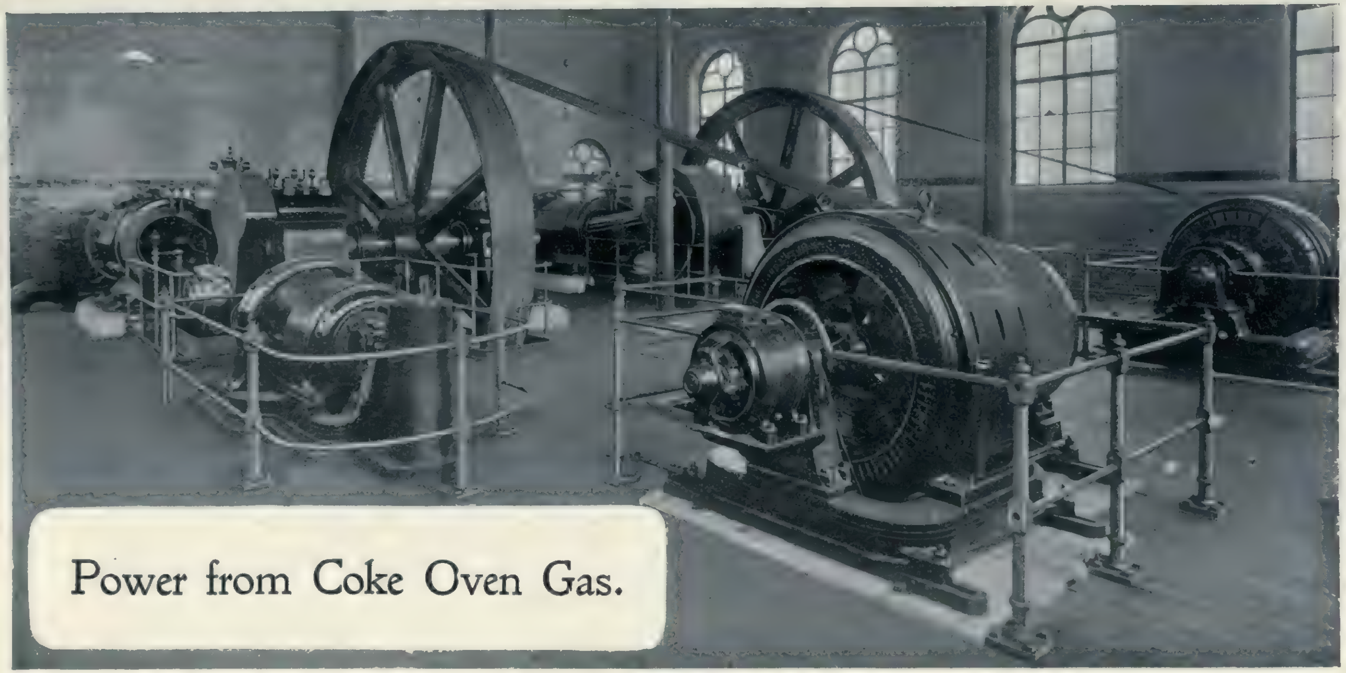
The mine will be ventilated in up-to-date fashion, and the student will have ample facilities for initiation into the mysteries of air-crossings and regulators, splits and scales, as well as the measuring of air-volumes and velocities.

The two chief methods of working coal, namely the "long-wall," and "bord-and-pillar" methods, are exemplified in the mine. By this means the mining students will be familiarised with the underground aspects of these two systems of working, of which all other systems of laying out coal workings may be regarded as modifications.

Research in ventilation is one of the most pressing needs of the day, and it is proposed to use the mine for exhaustive experiments in this direction. The effects of local or "secondary" ventilation rendered so interesting to mining engineers owing to the increased depths and temperatures of coal workings, will be studied, as also the question of friction, and the throttling of air-currents in a mine. A fan-house of special construction is being designed, which will permit of fans of different types being used at will for the purposes of demonstration of their special uses under different conditions. The fans will be driven by an electric motor, and part of the duty of the senior students will be such work as the plotting of efficiency curves of fans, and the determination of the laws of ventilation from experiments made. There will also be an apparatus, though probably not in the mine itself, for prosecuting researches into the various explosive mixtures of gas and air which are to be found in mines. In this chamber safety lamps, safety explosives, and firedamp detectors will be tested, and experiments will be carried on to demonstrate, and if possible to put some limit on, the terrible effects of a coal-dust explosion.

The direction in which the mine will probably prove of the greatest utility is that of underground surveying and levelling, and the connection of underground and surface surveys. Here the students will be enabled to complete the entire survey of a mine, surface and underground, from the setting out of the surface base-line to the traversing of the long-wall face, a thing which for obvious reasons could not be done by university students in a mine in the process of working, however willing the proprietor might be to grant facilities. This is of such practical utility as almost in itself to warrant the construction of a mine for experimental and educational purposes. It has already proved of much use in this respect, as the whole site was surveyed and levelled and the workings pegged out by the students before the work of excavation was begun.

Power from Coke Oven Gas.



ELECTRIC INSTALLATION AT TINGLEY, WITH "COCKERILL" ENGINES WORKED BY THE SURPLUS GAS FROM A BATTERY OF FORTY PATENT COKE OVENS.

The above illustration is from a photograph of a very interesting installation of gas engines recently installed at the Yorkshire Iron and Coal Company's Collieries at Tingley, near Leeds, under the direction of their Managing Director, Mr. James Riley, by Messrs. Richardsons, Westgarth and Co., Ltd., of Middlesbrough. This, we believe, is the first installation of large size put down in this country with gas engines using coke oven gas, the engines being worked by the surplus gas from a battery of 40 patent coke ovens, and as will be seen, the engines drive dynamos which are used for generating power for the underground haulage and lighting of the pits, and for various requirements at bank.

The engines are of the well known "Cockerill" type, of which Messrs. Richardsons, Westgarth and Co., are the sole makers in this country, each engine being 250 indicated horse-power when running at the normal working speed of 120 revolutions per minute. This installation has now been at work for some months with, we understand, very satisfactory results.

THE POWER PLANT
AT
HEYSHAM HARBOUR.

DETAILS OF THE ELECTRICAL PLANT.

THE beginning of September witnessed the inauguration of the Midland Railway Company's cross-channel service between Heysham and Belfast, new fast passenger and goods services in connection with the sailings having been arranged from and to London and to all the principal towns served by the company.

A detailed description of the Heysham Harbour scheme appeared in PAGE'S MAGAZINE for April, but at the time of our visit the power station was practically destitute of machinery, and it was only possible to give a brief description of the electrical plant which forms such an important part of the equipment at Heysham. By the courtesy of the British Westinghouse Company, we now supplement the information already given concerning this interesting plant and at the same time take the opportunity of reproducing a photograph received from Mr. R. M. Deeley, the company's locomotive superintendent, showing the new type of motor steam coach which is being used in connection with the Heysham service.

DETAILS OF THE POWER PLANT.

One of the most unusual features of the Heysham scheme lies in the fact that electric power is employed for practically all machines.

From the generating station, power and lighting feeders are run to sub-switchboards at three distribution points, known as A, B, and C. Of these, A and B are inside goods sheds on the south side of the large basin, where are the passenger and goods landing stages. Point C is on the north side of the harbour, near the fish stage. The system is three-wire continuous current, with 460 volts between the outer wires for the supply to motors, and 230 volts between middle wire and outers for incandescent lighting; the arc lamps are run two in series on 230 volts.

The two sub-switchboards in the goods sheds are connected together by balancing mains, so as to form a ring system, and are furnished with reverse current circuit breakers and with coupling switches for connecting the lighting feeders on to the power bus bars, or *vice versa*, thus allowing each board to be fed from either power or lighting feeders. From these two boards feeders are taken to twenty 100 ampere water-tight plugs for supplying the seven wharf cranes, other feeders being carried to supply seven platform cranes in the sheds, and twelve capstans. The feeders from the power house to the distribution points are all carried overhead, on a double H 40 ft. pole line, all the poles being set in concrete. At the last group of poles, close to the power house, the cables are carried down and into the power house through a trench running behind and below the main switchboard. The overhead conductors are lightly insulated, and hung by means of leather suspenders from No. 6 galvanised wire, made off on oil shackles at every pole.

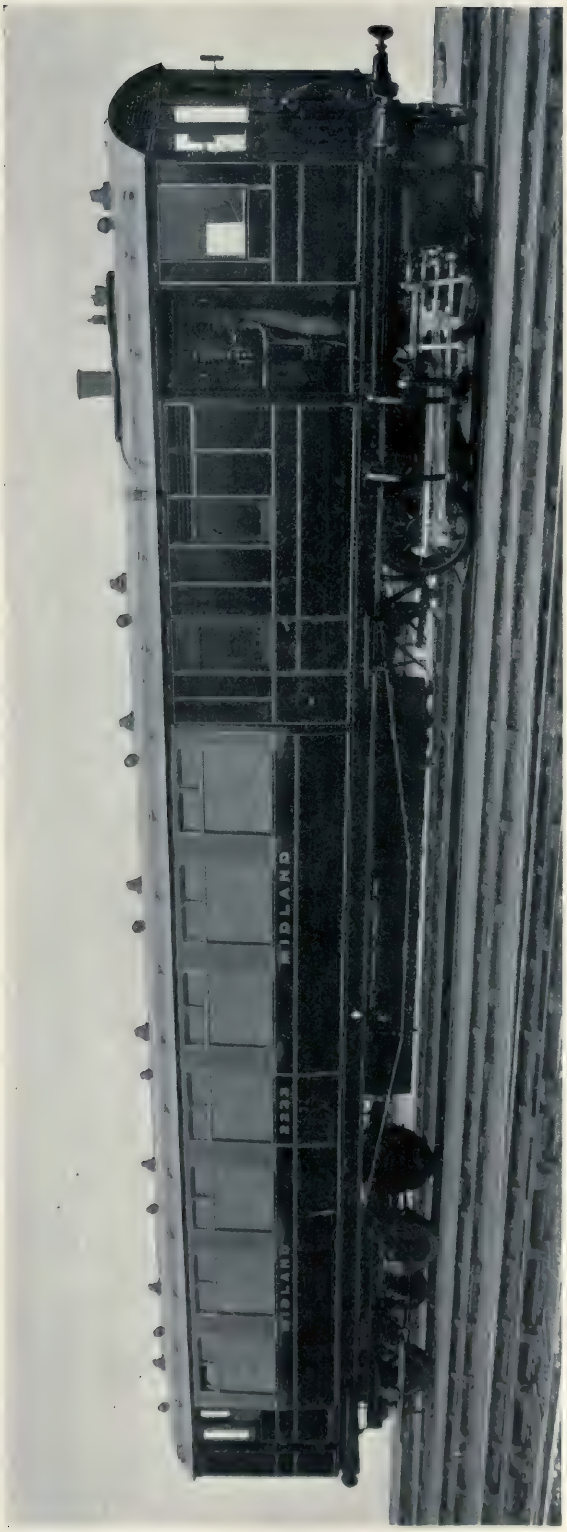
LIGHTING PLANT.

The docks, including landing stages, cart roads, sidings, passenger station, large and small goods sheds, engine house, etc., are lighted by 106 four-ampere Jandus arc lamps, each fitted with Siemens patent raising and lowering gear, and the equivalent of 1,000 sixteen-candle-power incandescent lamps. To compensate for the heavy tidal rise, which is often as much as 20 ft., it has been necessary to provide three landing stages, one above the other. As portions of the wiring for the lighting of lower and middle stages are submerged twice in each 24 hours, the wires are run in galvanised screwed heavy gauge steel piping, which is calculated to resist these unfavourable conditions. The lamps are, of course, also submerged, and are therefore enclosed in specially designed waterproof fittings. The lighting of the quayside is carried out by means of two-light fittings run on alternate circuits, and carried in lanterns on 10 ft. cast iron pillars, spaced about 60 ft. apart. All the wiring for the installation, as described above, was carried out by Messrs. E. J. Eckersley and Co., of Manchester, as sub-contractors to the British Westinghouse Electric and Manufacturing Company, Ltd., who executed the entire contract for electrical plant.

The electric power is generated by three gas-driven continuous current units in the power house, illustrated on page 299.

MOND GAS PRODUCERS.

The coal used in the Mond gas producers, constructed by the Power-Gas Corporation, Ltd., is bituminous slack, and each unit has capacity to gasify 700 lb. per hour. The slack is dumped from railway wagons direct into the elevator boot, and then raised by a bucket conveyor, which deposits it in a horizontal spiral conveyor, running across the tops of bunkers above each producer. Each bunker holds ten tons of small coal, and an Avery patent automatic weighing machine is fitted to each, to enable an accurate record of the consumption to be kept. The conveyors are driven by a 7½ b.h.p. Westinghouse motor, shunt wound, running at 1,850 r.p.m. The coal handling machinery was constructed by Messrs. Graham, Morton and Co., Ltd. From the scrubber the gas passes into the gas main, which runs outside the engine house alongside the three 250 b.h.p. gas engines. The gas is supplied to the engines through a regulator, from which it emerges practically at atmospheric pressure.



ONE OF THE NEW MIDLAND RAILWAY STEAM MOTOR COACHES.

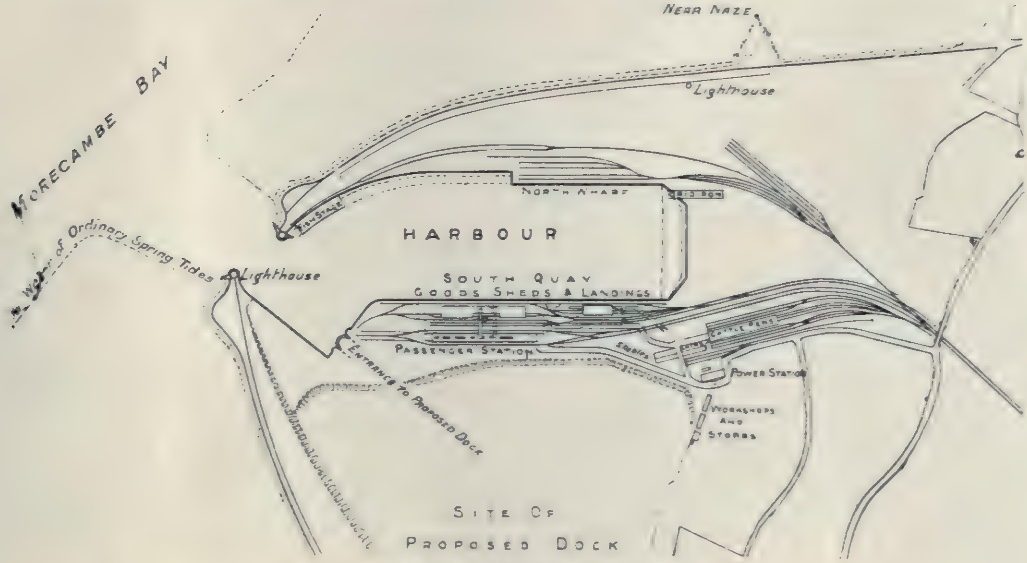
THE ENGINES.

The engines are of the Westinghouse vertical single-acting pattern, and run at the comparatively high speed of 200 r.p.m. The three cylinders are each 20 in. by 22 in., and the engines work on the Otto cycle, with high compression and electrical ignition. The admission and exhaust valves are both on one side of the engine, being in fact in the same vertical line for each cylinder, and are operated from a single cam shaft. This cam shaft is enclosed in the crank case of the engine, and operated from the main shaft by means of 2:1 gearing. The exhaust valve has a flat seating, and is directly actuated by an extension of the valve spindle, bearing upon a guide lever which is worked up and down by a cam. The inlet valve has a conical seating, and is above the exhaust; it opens downward instead of upward, and is actuated by a lever, the other arm of which is connected to a pull rod operated from the cam shaft. The crank case is enclosed, and the cranks in revolving dip in an oil bath, sufficient oil being thus splashed up to lubricate the working parts and the cylinders. No special cylinder lubricator is thus necessary. The bearings are self-aligning and have ample surface; they are oiled in the usual way by sight feeds. The governor is of the flyball type, driven by bevel gearing from the cam shaft. It acts by regulating the quantity of mixture admitted to the gas manifold, into which the inlet ports to the cylinders open. The quality of the mixture is not varied, and explosions are never passed, as in the "hit and miss" method of governing, so that the resultant speed regulation is very close. The fact that these engines have been used in numerous cases for the driving of alternators connected in parallel is sufficient guarantee of the excellence of the governing.

The engines are started by compressed air, stored in a battery of tanks charged by two small Westinghouse motor-driven air compressors. The entire operation of starting and running up to speed does not occupy more than one minute, a fact which constitutes an important advantage over a steam engine.

THE 150 K.W. CONTINUOUS CURRENT GENERATORS.

Each gas engine is direct coupled to a 150 kilowatt continuous current generator of standard Westinghouse pattern, giving a voltage of 430 to 460 volts and 325 amperes when working at normal speed. The machines are shunt wound, and the armature windings are of the balanced type, so that no undue pull will be exerted on the bearings should the armature get out of centre. The commutator is of large



PLAN OF HEYSHAM HARBOUR.

The position of the power station is shown to the right, near the workshops and stores.

diameter and allows liberally for wear; the copper and mica are of a hardness such as to ensure equal wear. The brush gear and arms have ample rigidity, and allow of ready adjustment of the pressure of brushes on commutator. The machines have eight poles, the pole pieces being laminated and cast into the vertically divided field frames.

MAIN SWITCHBOARD.

From the dynamos, leads are brought in trenches covered with iron checker plates to the main switchboard, which consists of 20 panels of black enamelled slate. Starting from the left hand, facing the board, the arrangement is as follows :—

First come three positive generator panels, then the positive battery panel. Then come two panels, which at the time when our photograph on page 299 was taken, were not in place ; of these one will be blank, and the other is for the control of various sub-boards. Next come a feeder panel, positive booster panels for power and for lighting, a panel for the middle wire of the three-wire system, and the negative panels for the power and lighting feeder boosters. Then come a blank panel and a sub-board panel—not then in place—battery booster panel, battery negative panel, and three negative generator panels, completing the board. The auxiliary apparatus in the power house includes two battery boosters, one balancer, and a power and a lighting feeder booster.

STORAGE PLANT, ETC.

The storage battery of the plant is a very large one, and consists of two sets each of 115 cells. Each cell has a minimum capacity after 12 hours' working of 180 amperes for six hours, with a final voltage of 1·85 volts, and the ampere-hour efficiency is 92·5 per cent. at a minimum.

The fire pumps are of Merryweather's Hatfield type. Each set consists of two of these pumps, one on each side of the motor, and each capable of delivering 350 gallons per minute at high pressure. The suctions are connected to an underground main, and the pumps deliver into a high pressure fire-main running round the premises. There are two sets of pumps, and they have a united capacity of 1,400 gallons per minute.

CRANES AND CAPSTANS.

The cranes and capstans at Heysham Harbour have all been built by Messrs. Stothert and Pitt, Bath, and electrically equipped by the British Westinghouse Company. There are six five-ton wharf cranes, of the half portal type, as illustrated on page 298, one two-ton wharf crane on a gantry, and six 30-cwt. platform cranes in the goods sheds. The five-ton cranes have fixed jibs, and a radius of 30 ft. from the revolving centre to the centre of the hook when lifting with the snatchblock. The five-ton cranes have lifting and slewing motions worked by two separate motors. For lifting, a Westinghouse traction motor, rated at about 40 h.p., 300 r.p.m., is used, and for slewing a Westinghouse SB motor, 8 h.p., at 700 r.p.m. The traction motor is, of course, series wound. The lifting and slewing motor is mounted on cast iron frames secured to a bed which is bolted to the wrought steel girders of the superstructure, which revolves on the undercarriage by means of two cast steel roller paths with an intermediate ring of live steel rollers ; this arrangement gives great use in slewing. The jibs are of rolled sections, strongly braced and fitted with a ladder for access to the jib pin. The tie rods are connected to the top of the steel A frame, the two frames being braced together in a lateral direction. The centre pin of the crane is placed two feet within the line of the outer rail. The tail of the crane is about 12 ft. 6 in. long measured from a revolving centre.

The lifting gear is single purchase, the pinion on the armature gearing directly into the spur wheel on the barrel shaft, the barrel is spirally grooved and will coil sufficient rope in one lap to give a total rise of hook, when using the snatchblock, of 85 ft. The rope is also fitted with a hook on the end, so that it can be used as a single part of rope without the snatchblock when required.

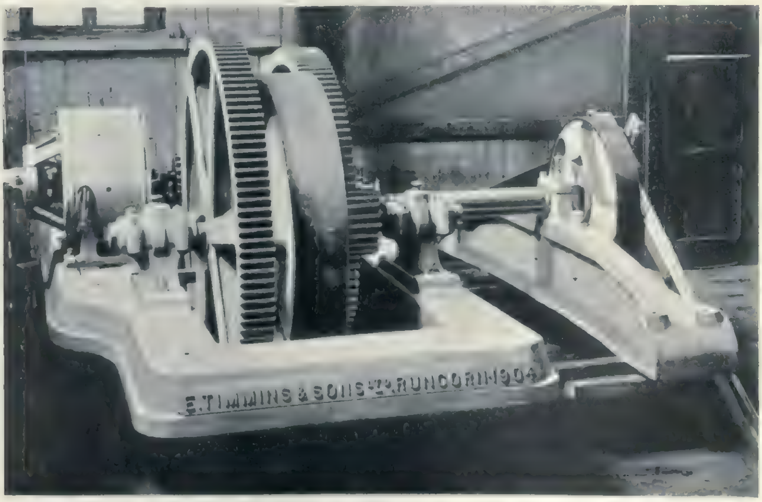
Perhaps the most interesting feature of these cranes is the patent free barrel attachment fitted by Messrs. Stothert and Pitt under their patents. By this arrangement, the lifting barrel is not keyed directly to the shaft, but runs loosely upon it, being connected or disconnected by a coil clutch. In this way the lifting motor always runs in one direction and is never reversed. A great advantage claimed for the free barrel arrangement is the greatly enhanced speed of working which is allowed by its use. Another valuable point is the reduced liability of accident to the motors, owing to the fact that they are never reversed, and the impossibility of suddenly stopping the armature.

ONE OF THE FIVE-TON WHARF CRANES.

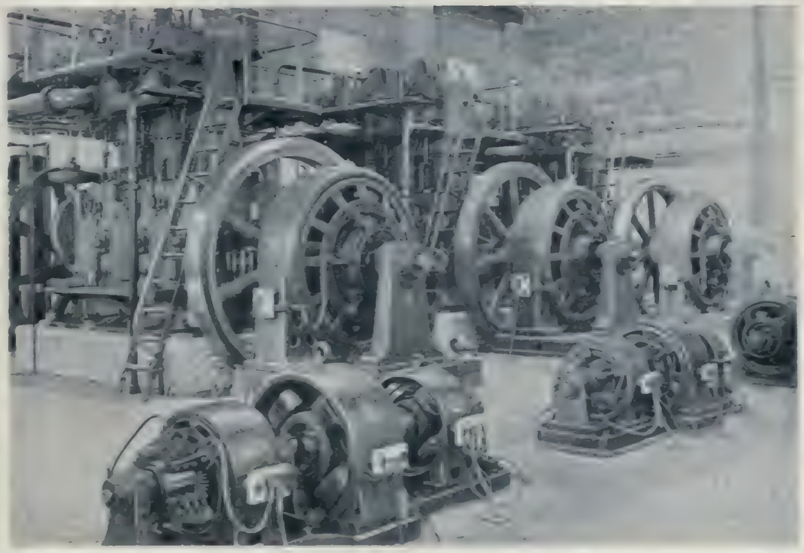
Speeds of working are 100 ft. per minute and 400 ft. per minute at the hook for slewing, and double the speed at lift for half the weight can be obtained by unshipping the snatchblock, and unslinging the hook at the end of the rope from its eye at the jib head, and so using it for lifting in single purchase. Double reduction gear is employed for the slewing motion. Plug fittings have been placed every 40 ft. to convey current to the cranes, and a round twin 98/20 flexible cable armoured with galvanised iron wire is employed.

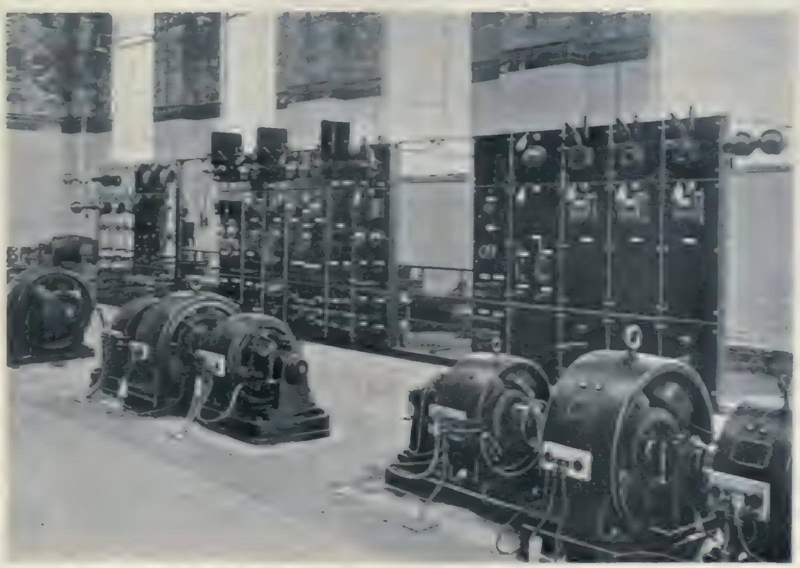
The two-ton crane is of similar design to the six five-ton cranes except that it is mounted on a gantry, which runs on rails on the same level at 15 ft. centres. This lifts two tons at a radius of 33 ft. at 250 ft. per minute, and slews at 400 ft. per minute. The lifting motor is 40 h.p. Westinghouse traction type, and slewing motor 4 h.p.

In addition to the contract plant supply of electric cranes, Messrs. Stothert and Pitt have furnished for the works ten one-ton and two three-ton capstans driven by Westinghouse motors. These capstans are self-contained in cast iron boxes, and cast iron checker plate covers are fitted on the boxes, with hand holes to provide access to the motor bearings. The covers are so made that they can be readily removed. The motors for both the three-ton and the one-ton capstans are the same, viz., 20 b.h.p., running at 700 revolutions, the gearing being treble purchase in the three-ton capstans, and double purchase in the one-ton capstans, giving a pull of three tons at three-quarters of a mile per hour, and one ton at two and a half miles per hour respectively. The capstan controller mechanism has been worked out in detail by the Midland Railway, and made by the British Westinghouse Company. It is actuated by a foot plunger working in a vertical direction, and is provided with overload cut-off and other special safety arrangements. Two Waygood lifts are provided to take passengers and goods to and from the upper and lower landing stages. The most unusual feature about these is that they are provided with water level cut-offs, so that it is impossible for the lift to come down to the lower level landing stage when this is below water. The cars are, moreover, buoyant, so that no accident would happen if they did travel too far down.



MOTOR-DRIVEN PUMP FOR THE HEYSHAM WATER SUPPLY.





THE POWER STATION AT HEYSHAM HARBOUR.

(1) Generating Plant. (2) Main Switchboard.

They are fitted with the usual car-switch control, over-travel cut-off, etc., and each is driven by a Westinghouse motor of 20 h.p.

DRIVING PUMPS.

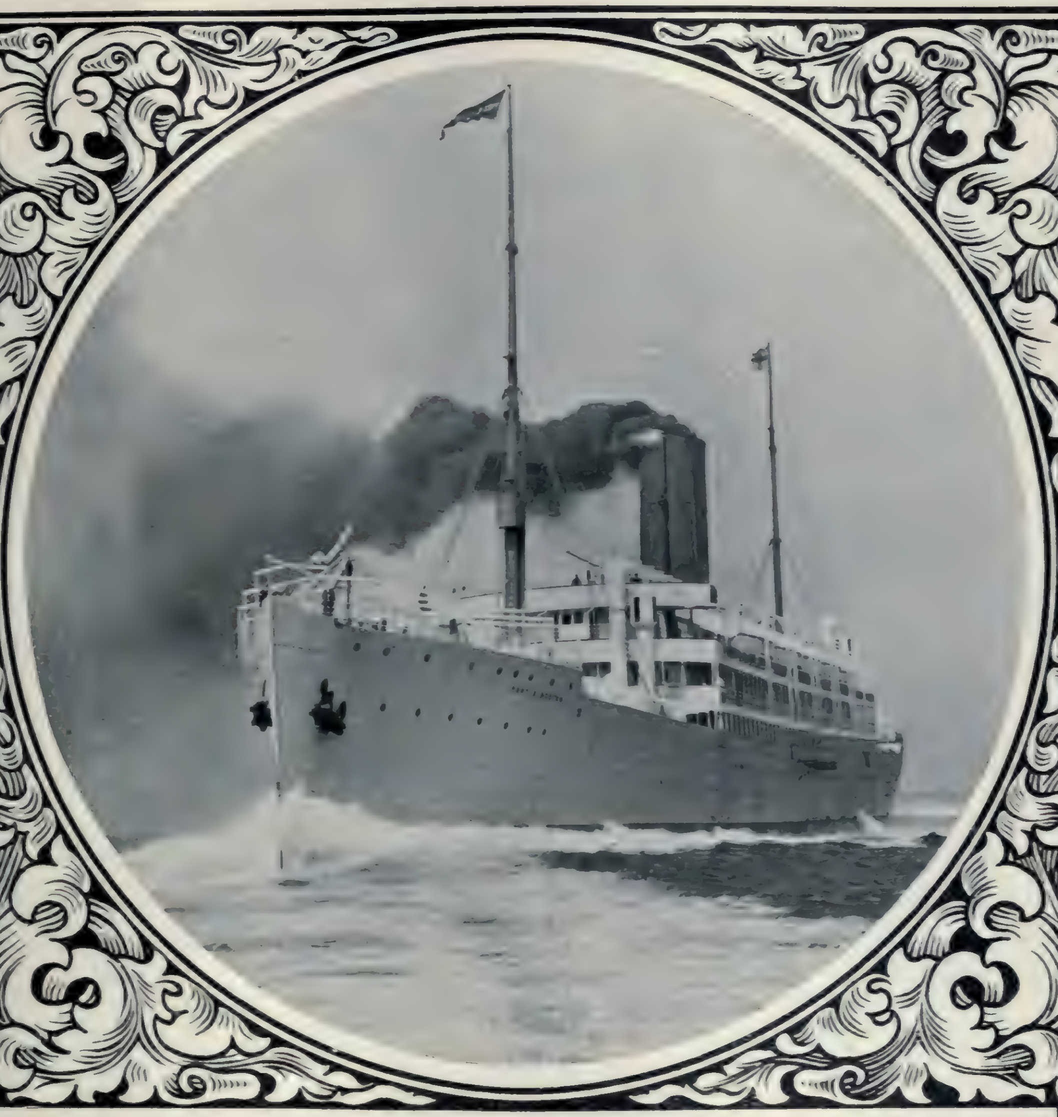
Naturally the water supply is an important feature of the installation. The illustration on page 298 shows the pump in the shops of Messrs. Timmins, the makers, prior to leaving their works for erection. The pump is capable of delivering 288,000 gallons of water per day through a 6 in. main, 1,550 yards long, into a reservoir of 392,850 gallons capacity, 38 ft. above the rail level of the harbour. The motor is 25 h.p. Westinghouse protected type, running at 850 revolutions per minute. The wheel gearing consists of cast iron machine cut spur wheels, and Reid's patent paper pinions; the intermediate shaft has a balance flywheel.

The main pump shaft is fitted with disc crank overhanging well girder for driving pump. The automatic starting and stopping is controlled by the variation of level for water in the reservoir by the motion of a float, which opens the circuit of a snap switch, and stops the motion when the maximum reservoir water level is reached, and re-starts it when this level has fallen 3 ft., or other suitable distance. To give warning in either case of the water rising above or falling below certain levels, an arrangement of bells ringing in the pump house is arranged.

The contract for the whole of the power plant, including the building of the power station, was carried out by the British Westinghouse Electric and Manufacturing Company, Limited, under the supervision of the Midland Railway Company's chief locomotive engineer.

THE NEW STEAM MOTOR-COACHES.

The new steam motor-coach illustrated on page 296, is divided into four sections, viz., the engine room, passenger compartment, luggage compartment, and vestibule. The total length is about 60 ft., and it will accommodate some fifty-five passengers together with their luggage. The boiler is of the vertical multitubular type, with a steam pressure of 160 lb. There are two 11 in. steam cylinders with a 15 in. stroke operating one pair of bogie wheels. These latter are coupled to the other pair of the same truck. The valve gear is of the same type as that in use on the Great Western Railway Company's steam motor-carriage, viz., the Walschaert. The vehicle can be started and stopped from either end of the car, the stopping and starting apparatus being duplicated to enable this to be done. The total weight of the coach in running order is 36 tons, and it travels at an average speed of about thirty miles per hour.



THE STEAM SHIP "PORT KINGSTON."

This fine vessel of 7,600 tons and 10,000 i.h.p. has been built by Messrs. Alexander Stephen and Sons, of Glasgow, to the order of the Elder Dempster Company for service on the Imperial Direct West India Mail line, between Bristol and Jamaica. Her general dimensions are: Length over all, 475 ft.; breadth, 55 ft. 6 in.; depth, 30 ft.; gross tonnage, about 7,600 tons. She has a poop, a long bridge-house, and a forecastle in the upper deck—the deck over the bridge-house being carried out to the side, and supported from the bulwarks by stanchions, forming a sheltered alleyway on each side of the upper deck. On the bridge-deck is a large deck-house, covered by the boat-deck, which supports the boats, and forms a spacious promenade for passengers, 210 ft. long and from 18 ft. to 20 ft. wide, with covered recesses at intervals, the whole being completely sheltered by double awnings. She is in every respect an up-to-date vessel, both as regards the conveyance of passengers and produce. The holds insulated for the carriage of fruit are of a capacity of over 100,000 cubic feet, sufficient for the stowage of 40,000 bunches of bananas and 15,000 cases of other fruit, and are divided up into bins, and refrigerated in the latest and most approved manner.

At the recent inauguration of the vessel at Bristol, Sir Alfred Jones did not deny that the *Port Kingston* had been built in advance of the immediate requirements of the service. He was, however, accustomed to look ahead, and felt confident of ultimate success. At the same time, he was a business man and not a philanthropist. He meant to succeed, and he wanted other people associated in the enterprise to look at it in the same light that he did—as a great Imperial undertaking for which some sacrifices must be made at the outset if success was to be attained in the end. He wanted Bristol to help him—and he must confess that Bristol had not so far helped him as much as he had tried to help Bristol—he wanted the Dock Company to help him, and he wanted the railways to help him with reasonable rates for the carriage of tropical fruit and reasonable facilities for its distribution.

HYDRAULIC POWER IN MINES.

Professor Henry Robinson on Hydraulic Power and Hydraulic Machinery.

THE third edition of Professor Henry Robinson's valuable work "Hydraulic Power and Hydraulic Machinery," just published by Messrs. Griffin, has been rendered additionally useful by the incorporation of recent information. It describes many interesting types of hydraulic machinery and comprises a series of short compact articles written in lucid and informing style. By the courtesy of Messrs. Griffin we quote the following details of a pumping plant erected by Messrs. Easton and Co., of Erith, for the Tasmania Gold Mining Company, who wished to increase the depth of their existing shaft from 718 ft. to 918 ft., which involved increased pumping power.

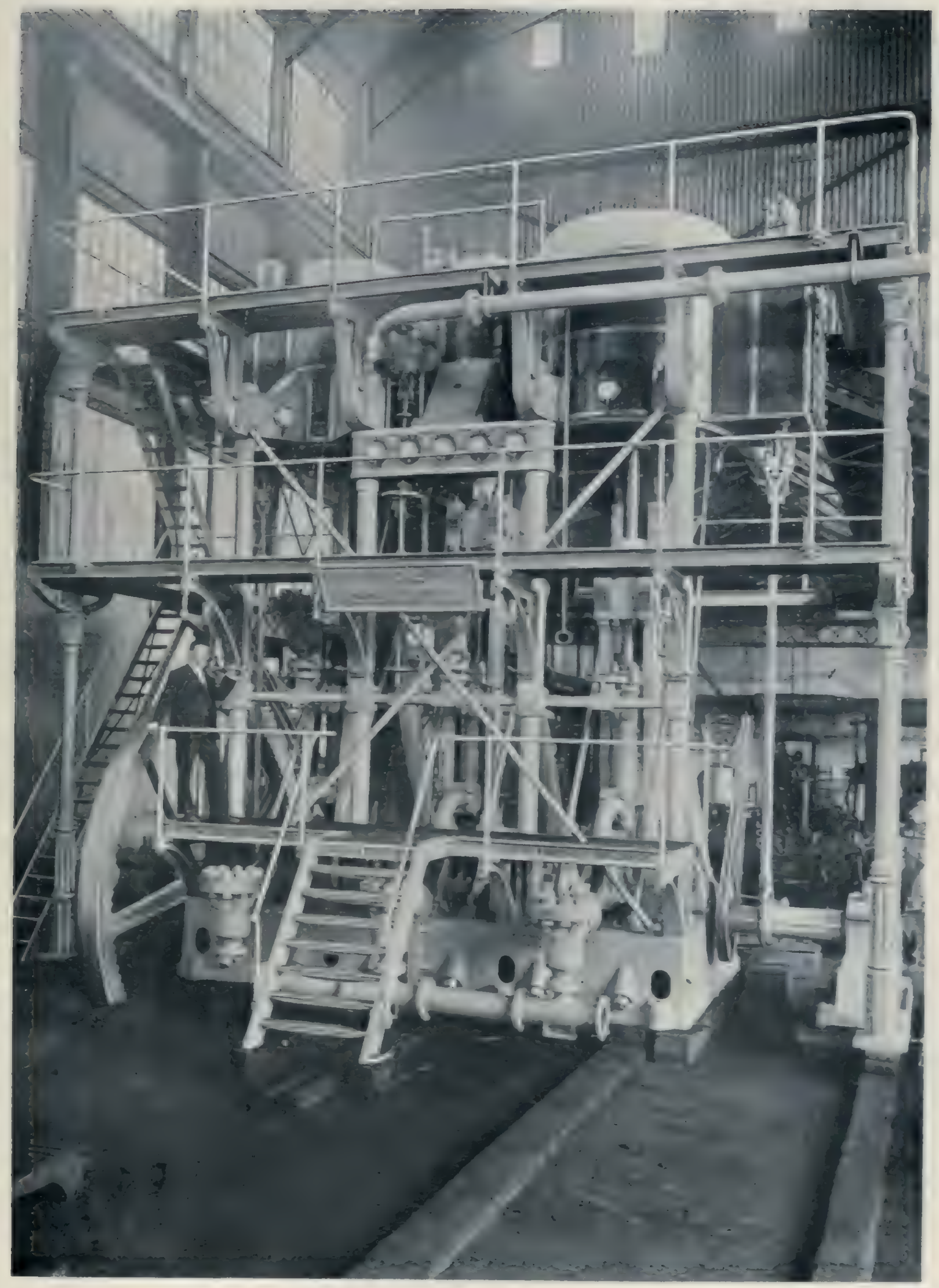
The difficulty in fixing a new engine was that the shaft would not admit of another set of spear rods being installed. Furthermore, it was desired to make use of a spare set of pumps which were at the mine. The arrangement adopted was as follows: A hydraulic motor was fixed at the 718 ft. level, working by means of spear rods the pumps at the low level, and driven from a new engine at the surface placed in an engine-house some distance away from the shaft, the water being carried to the hydraulic motor in the shaft through solid drawn steel piping, the exhaust being returned to the suction tank at the engine house.

The engine, illustrated herewith, is of the usual triple-expansion, inverted-cylinder type, having cylinders 25 in., 40 in., and 69 in. diameter by 42 in. stroke, the pumps being placed directly below the crosshead, and in line with the piston rod. The crossheads are provided with two gudgeons, and are connected to the crankshaft by double connecting rods of rectangular section. The crankshaft is built up and made in two pieces bolted together by a coupling for facilitating transport. The cylinders at the back are supported on massive cast-iron frames of box section, which also carry the pumps. The intermediate pressure and low-pressure cylinders are each supported on two steel columns in front. The two middle columns are connected by a cast-iron box girder, which carries the front side of the high-pressure cylinder, and the three cast-iron columns at the back are connected by distance pieces. The cylinders are entirely separate so as to allow of free expansion, and are jacketted throughout. The high-pressure is fitted with a piston valve with internal expansion valve. The intermediate-pressure is fitted with a flat side valve with an expansion valve on the back; and the low-pressure cylinder is fitted with a double-ported slide valve. The intermediate-pressure and main valve, and the low-pressure valve, are supported by balance cylinders on the top, so as to reduce the stress on the eccentric rods. The pumps and valve boxes are of cast steel, with phosphor bronze rams and valves and seats. The bedplate is cast in halves, bolted together, and is of box section. As the thrust on the guides came rather high up on the back columns, the latter are supported by diagonal tie rods from the front of the bedplate. The front columns are also braced diagonally to prevent vibration. The engine is provided with a large flywheel on each side. The starting gear and all cocks are arranged to be worked from the lower platform, but may also be worked from the second platform.

A complete system of lubrication is arranged for continuous working. The engine is fitted with a throttle valve, which is shut by a knock-out governor when the speed exceeds the fixed maximum. It is also shut when the accumulator on the main reaches its top position. In case the main should burst, the valve is also shut by a weight which is normally held up by a small plunger connected to the delivery pipe. It will be seen that the three platforms fixed round the engine give easy access to all the parts. Steam at 170 lb. pressure is supplied from four Cornish multitubular boilers, 6 ft. 3 in. diameter and 20 ft. long. A surface condenser with air and circulating pumps driven by a small horizontal engine is to be fixed behind the engine. Provision is also made for exhausting into the atmosphere if necessary. The water is delivered from the pumps at a pressure of 2,100 lb. per square inch.

The work is so arranged that it can be taken up with profit and advantage at any odd moment, while a complete index is provided rendering it valuable for reference purposes.

It is interesting to note that the author, who draws upon a wide range of experience, carried out at Hull the first public hydraulic power installation, this having been the first town for which an Act of Parliament was obtained to lay high-pressure hydraulic mains under the public streets for the supply of water power on the co-operative system.



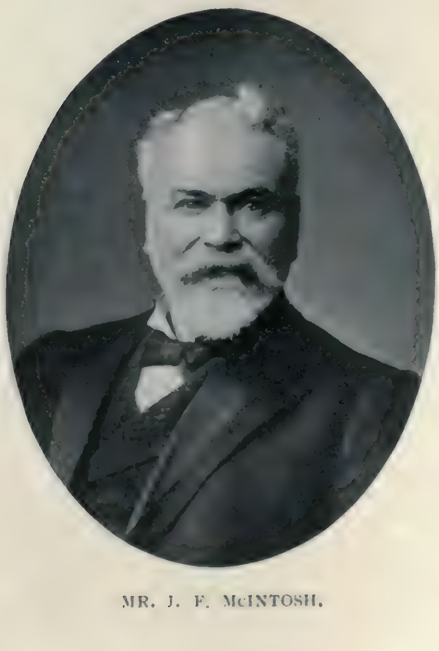
From "Hydraulic Power and Hydraulic Machinery."]

HYDRAULIC PUMPING ENGINE FOR TASMANIA.

Our Monthly Biographies.

MR. JOHN FARQUHARSON McINTOSH.

JOHN FARQUHARSON McINTOSH, superintendent of the locomotive, carriage, and wagon departments of the Caledonian Railway at St. Rollox, Glasgow, is a native of Forfarshire, having been born in the neighbourhood of the east coast seaport of Montrose. At the age of fourteen years he entered the service of the Scottish North-Eastern Railway (before its absorption by the Caledonian Railway Company), and received his practical mechanical training in their Arbroath workshops. He afterwards qualified himself in the usual courses of departmental work, and in the working of locomotives. In 1876 he was appointed locomotive inspector of the northern section of the Caledonian Railway. Six years later he was made district locomotive foreman at Aberdeen, was subsequently promoted to Carstairs, and eventually took charge of the Company's most important engine shed at Polmadie, near Glasgow. In 1891 he assumed the duties of chief inspector of the running department in the locomotive superintendent's office, St. Rollox, and ten years ago was appointed to his present position of locomotive, carriage, and wagon superintendent of the Company in succession to the late Mr. John Lambie. He is a member of the Association of Railway Locomotive Engineers, the Iron and Steel Institute, the Society of Engineers and Shipbuilders of Scotland (and has acted on the Council), the Railway Companies' Association "Standardisation of Locomotives" Committee, and the Institute of Civil Engineers' "Engineering Standards" Committee. Mr. McIntosh acted on the Committee of the Mechanical Section of the International Engineering Congress (1901), and is patentee of several mechanical appliances. He was awarded a medal for his "Dunalastair" type of locomotive at Brussels Exhibition of 1897, and the following year a party of experts from the Belgian Government railways, after studying British railway methods as demonstrated in everyday work on the principal routes, decided upon following the Caledonian practice, with the result that Mr. McIntosh was requested by the Belgian Government to design a type of locomotive for the international express service on their State railways, which unique commission, with the consent and approval of his directors, he accomplished with entire satisfaction.



MR. J. F. McINTOSH.

"Page's Magazine"

WILL BE CHANGED INTO A

Sixpenny Weekly Journal

. . ON . .

OCTOBER 14th.

WE have only to turn to the first issue of "Page's Magazine" to be reminded that our motto is "Qui non proficit, deficit,"* and with feelings of more than ordinary pleasure we are now able to announce to our many readers and subscribers that, commencing Friday, October 14th, "Page's Magazine" will be published under the new title of **"Page's Weekly,"** the price being reduced to sixpence.

The change has not been decided upon hastily, nor without very serious consideration. We have been encouraged to take this important step by the marked success which has attended our efforts in connection with the present monthly issue, and by a desire to respond to the wishes of many engineering friends.

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* He who does not advance, loses ground.

We have been gratified to receive regularly from many of our readers at home and abroad expressions of opinion which tend to show that the subject matter published in "Page's Magazine" has been much appreciated, and has filled its own appropriate niche in the engineering world. The issue of the magazine *monthly*, however, has rendered it impossible to deal satisfactorily with items of news which have come to hand immediately after we have gone to press, and this reason, *inter alia*, has led us to arrange for its publication at more frequent intervals. Notwithstanding this drawback, few journals devoted to strictly technical subjects have established themselves so firmly in public estimation, or achieved the same amount of success in such a short period, as "Page's Magazine" has, during its comparatively brief existence, and we enter upon our enlarged sphere of operations with confidence, foreseeing that we shall, in future, be in a far better position to produce an up-to-date journal.

It is perhaps unnecessary to add that our editorial staff, outside contributors, and foreign correspondents, have been largely augmented, and our arrangements for news, other technical information, and special articles, have been greatly extended.

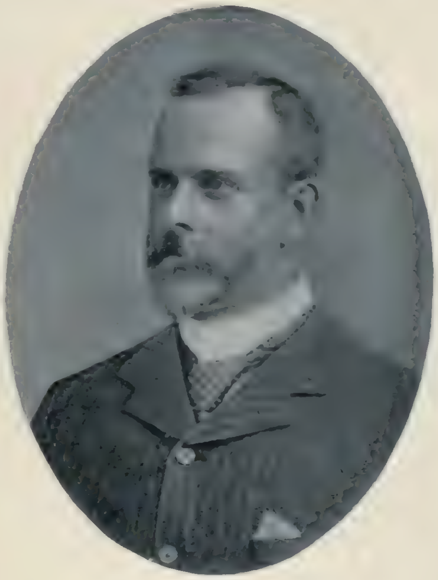
The new journal will be sent *weekly*, without any extra charge, to all existing subscribers to "Page's Magazine" until their orders expire.

Clun House,
Surrey St., Strand, W.C.

MR. WILLIAM HENRY PATCHELL,

M.Inst.C.E., M.I.Mech.E., M.I.E.E., etc.

WILLIAM HENRY PATCHELL, M.Inst.C.E., M.I.M.E., M.I.E.E., etc., was born in 1862. His early education was received at King Edward VI.'s Grammar School, Louth. He subsequently served a five years' apprenticeship with Messrs. Robey and Co., of Lincoln, and after being on their staff at the Paris Electrical Exhibition in 1881, he was sent ou to Spain, where he was engaged in the earlier attempts to introduce electric light to Barcelona, Valencia, Madrid and Cordova. On leaving Messrs. Robey's employ in 1886, he went to the Electrical Power Storage Company to superintend the lighting installation at the Folkestone Exhibition, and in the same year was appointed manager of their works at Millwall. In March, 1893, he was appointed engineer-in-chief of the Electric Supply Corporation, which was then only supplying in the parish of St. Martin-in-the-Fields. The name of the company was subsequently changed to the Charing Cross and Strand Electricity Supply Corporation, and the area of supply increased on the acquisition of Parliamentary powers to supply in the Strand district (1895), the Holborn and St. Giles district (1898), and the City of London (1899). Mr. Patchell has been responsible for the designing and carrying out of the whole of the necessary extensions and new works, which included a generating station at Lambeth, started in 1896 supplying 1,000 volts continuous current, and a generating station at Bow, started in 1902, supplying 10,000 volts three-phase current, with the necessary sub-stations in the West End and City to handle the current generated at the above-mentioned stations. During the period that Mr. Patchell has been responsible for engineering the Corporation, the lamps connected have increased from 30,000 to 650,000. Mr. Patchell is a vice-president of the Institution of Electrical Engineers, and a member of the Home Office Committee appointed to inquire into the use of electricity in mines. He is the author of a paper on "Steam Superheating," read before the Institution of Mechanical Engineers in 1896, and a frequent contributor to the discussions at the Institutions of which he is a member.



MR. W. H. PATCHELL,
M.Inst.C.E., M.I.Mech.E., M.I.E.E.

THE INTERNATIONAL ELECTRICAL CONGRESS.

THE International Electrical Congress, held under the auspices of the Louisiana Purchase Exposition, is a remarkable gathering, not only by reason of the number and variety of the papers read, but also because of the cosmopolitan character of the attendance, electrical engineers from every part of the world being enabled to exchange ideas and compare notes on current progress. This conference involved the co-operation of the American Institute of Electrical Engineers, the American Electro-Chemical Society, the American Physical Society, the National Electriç Light Association, the Association of Edison Illuminating Companies, the International Association of Municipal Electricians, and the American Electro-Therapeutic Association. An invitation extended to the Institution of Electrical Engineers of Great Britain to hold a joint meeting at St. Louis in connection with the Congress, was cordially accepted.

The Committee of Organisation of the Congress is as follows :—

President : Elihu Thomson, Past President of the American Institute of Electrical Engineers.

Vice-Presidents : Mr. B. J. Arnold, President of the American Institute of Electrical Engineers ; Professor H. S. Carhart, President of the American Electro-Chemical Society ; Professor W. E. Goldsborough, Chief, Department of Electricity, Louisiana Purchase Exposition ; Mr. Chas. F. Scott, Past President of the American Institute of Electrical Engineers ; Dr. S. W. Stratton, Director of the National Bureau of Standards of the United States.

General Secretary : Dr. A. E. Kennelly, Past President of the American Institute of Electrical Engineers.

Treasurer : Mr. W. D. Weaver, Editor of the "Electrical World and Engineer."

The proceedings of the Congress extended over the week commencing September 12th, when the opening ceremonies were held in the Music Hall of the Coliseum, at Olive and Thirteenth Streets.

Nearly two thousand acceptances, or, to be exact, 1,915, were received, of which 1,542 were from North America, and 373 from other countries.

ENGLISH VISITORS.

The following members of the Institution of Electrical Engineers and friends have joined in the American visit : Mr. R. Kaye Gray, president and delegate ; Lieut.-Col. C. B. Crompton, R.E., past president and delegate ; Professor John Perry, past president and delegate, (Miss A. M. Perry and Miss A. Stower) ; Dr. R. T. Glazebrook, member of council and delegate ; Mr. F. E. Gripper, member of council ; Mr. Robert Hammond, honorary treasurer and member of council, (Miss Hammond) ; Mr. H. E. Harrison, delegate ; Mr. W. Duddell, honorary secretary to the Institution Delegation ; and Messrs. A. F. T. Atchison, Birmingham ; George Balfour, London ; R. S. Ball, London ; W. A. Barnes, Manchester ; D. Bates, Liverpool, (Mrs. Bates) ; G. Conrad Blair, Paisley ; R. Blennerhassett, Schenectady, U.S.A. ; John T. Connolly, Manchester, (Mrs. Connolly) ; Professor J. D. Cormack, London, (Mrs. Cormack); J. R. Dick, Brighton; James Edgar, Wrexham ; R. S. Erskine, London, (Mrs. Erskine) ; W. P. J. Fawcus, Manchester ; T. Feilden, London ; J. A. Foster, London ; W. Geipel, London ; Professor W. E. Goldsborough, Purdue, U.S.A. ; E. C. Handcock, Lynn, U.S.A. ; W. A. Harris, Trinidad ; C. C. Hawkins, Bedford ; M. Hayashi, London ; C. Hering, Philadelphia, U.S.A. ; Thomas Hesketh ; Folkestone, (Mrs. Hesketh) ; O. Higman, Ottawa, Canada ; F. Hope-Jones, London ; S. Insull, Chicago, U.S.A. ; M. Jennison, Manchester ; Dr. A. E. Kennelly, Cambridge, Mass., U.S.A. ; W. N. Kernot, Melbourne ; F. C. Kidman, Wallsend-on-Tyne ; J. D. Knight, London ; E. H. Liebert, Rochdale ; G. C. Lloyd, secretary, London ; F. M. Long, Norwich ; B. Longbottom, Manchester ; R. S. McLeod, Manchester ; C. O. Mailloux, New York, U.S.A. ; J. L. Marr, Sunderland ; W. B. Marr, Sunderland ; J. Marshall, Cheltenham ; R. B. Matthews, Swansea ; F. O. Mills, Manchester ; Dr. D. K. Morris, Birmingham; J. T. Morris, London; A. E. Morrison, Prince Edward Island; L. G. E. Morse, London ; F. H. Nalder, London ; F. Nichols, Toronto, Canada ; Professor R. B. Owens, local hon. secretary for Canada, Montreal, Canada ; R. B. Perring, Buxton ; W. G. T. Pope, Lisbon, (Mrs. Pope) ; A. P. Pyne, Gateshead ; Calvin W. Rice, New York ; G. H. C. Risch, Johannesburg; E. B. Schattner, Schenectady ; E. Kilburn Scott, London ; W. H. Scott, Norwich ; P. S. Sheardown, Dublin ; H. B. Simons, Manchester ; W. Summerscales, Leeds ; C. D. Taite, chairman, Manchester Local Section, Manchester ; Professor Elihu Thomson, Mass., U.S.A. ; M. J. E. Tilney, London ; R. Tree, chief clerk, London ; J. M. Wallwin, Manchester ; G. G. Ward, local hon. secretary for U.S.A., New York ; A. C. F. Webb, Sydney, N.S.W. ; H. G. Whiting, Cork ; G. Wilkinson, Harrogate ; Capt. R. Ff. Willis, Barbados, (Mrs. Willis) ; L. Wilson, Pittsfield, U.S.A. ; and E. B. Woollan, Tunbridge Wells.

OPENING THE CONGRESS.

Immediately following the opening ceremonies, eight sections commenced their meetings on the second floor of the Coliseum, as follows :—

SECTION.	SUBJECT.	CHAIRMAN.	SECRETARY.
A	General Theory.	Dr. E. L. Nichols, Cornell University.	Prof. H. T. Barnes, McGill University.
B	General Applications.	Dr. C. P. Steinmetz, Union College.	Prof. Samuel Sheldon, Brooklyn, N.Y.
C	Electrochemistry.	Prof. H. S. Carhart, University of Michigan.	Mr. Carl Hering, Philadelphia, Pa.
D	Electric Power Transmission.	Mr. C. F. Scott, Pittsburg, Pa.	Dr. Louis Bell, Boston, Mass.
E	Electric Light and Distribution.	Mr. J. W. Lieb, Junr., New York.	Mr. Gano S. Dunn, New York.
F	Electric Transportation.	Dr. Louis Duncan, Mass. Inst. Technology.	Mr. A. H. Armstrong, Schenectady, N.Y.
G	Electric Communication.	Mr. F. W. Jones, New York.	Mr. B. Gherardi, New York.
H	Electro-therapeutics.	Dr. W. J. Morton, New York.	Mr. W. J. Jenks, New York.

EXCURSIONS.

The arrangements made to welcome the European visitors were of a very thorough character, Mr. E. H. Mullin acting as chairman of the Committee on Transportation and Arrangements, and Mr. J. W. Lieb, junr., of the Joint Reception Committee. A very instructive excursion programme was arranged, the itinerary bringing under the notice of visitors the chief points of electrical interest successively in Boston, New York, Schenectady, Montreal, Niagara Falls, Chicago, St. Louis, Pittsburg, Washington and Philadelphia. The following are some of the items from the programme—

September 3rd.—Boston. Reception of visiting members at the wharf; visit to power house; visit to Massachusetts Institute of Technology; reception at Harvard University.

September 4th (Sunday).—New York. Steamboat excursion, Hudson River.

September 5th.—New York. Inspection of new subway; tour of electrical power stations of New York City, concluding with a visit to the waterside station of the New York Edison Company; reception of all foreign visitors by the American Institute of Electrical Engineers, and banquet.

September 6th.—Schenectady. Commencement of special circular tour for foreign delegates, visit to the works of the General Electric Company. Evening excursion in special high-speed trolley cars to Albany.

September 7th.—Montreal. Visit to local power plants; afternoon, reception at McGill University.

September 8th.—Visits around Montreal.

September 9th.—Niagara Falls. Visit to the Falls and trip down the gorge to view whirlpool and rapids; visits to power houses of Niagara Falls Power Company, Niagara Falls Hydraulic Power Company, and some of the electro-chemical manufactories whose power is supplied by these companies.

September 10th.—Chicago. Visits to power stations, public parks, etc.

September 11th (Sunday).—Springfield. Trip in trolley cars to Lincoln's tomb. St. Louis. Informal reception at Jefferson Hotel.

September 12th to 17th.—International Electrical Congress.

September 18th (Sunday).—Pittsburg.

September 19th.—Pittsburg. Visit in trolley cars to offices and works of Westinghouse Electric and Manufacturing Company. Afternoon visit to Edgar Thomson Steel Works and foundries of the Westinghouse Air Brake Company.

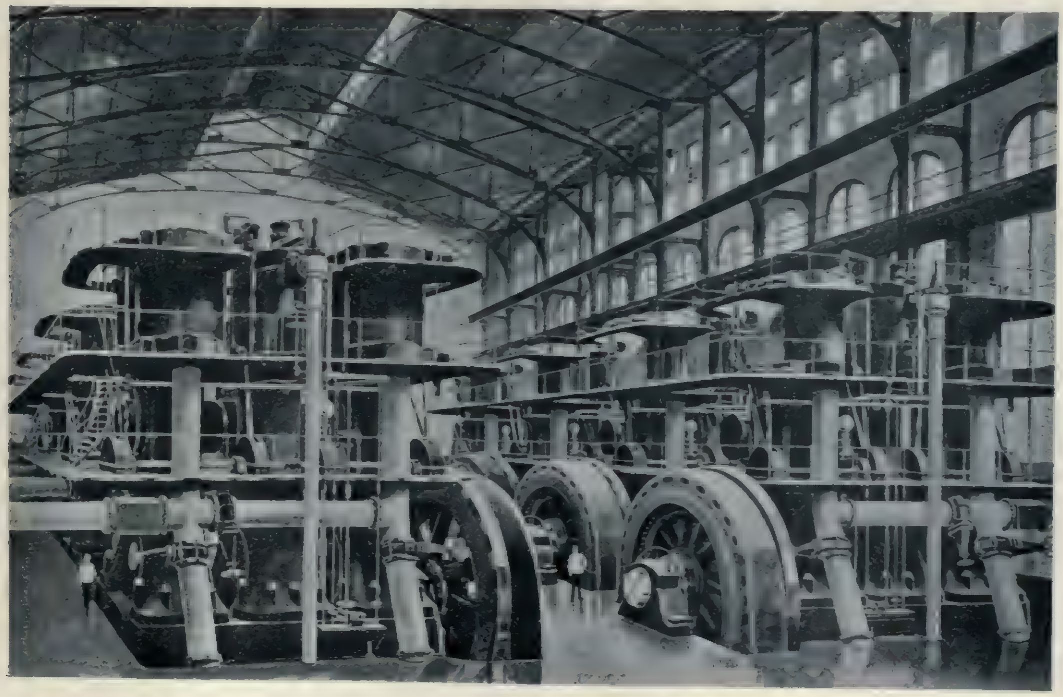
September 20th.—Washington. Visit to recently erected offices and laboratories of the United States Bureau of Standards; afternoon visit to White House, etc.

September 21st.—Philadelphia. Visits to power houses, Independence Hall, etc.

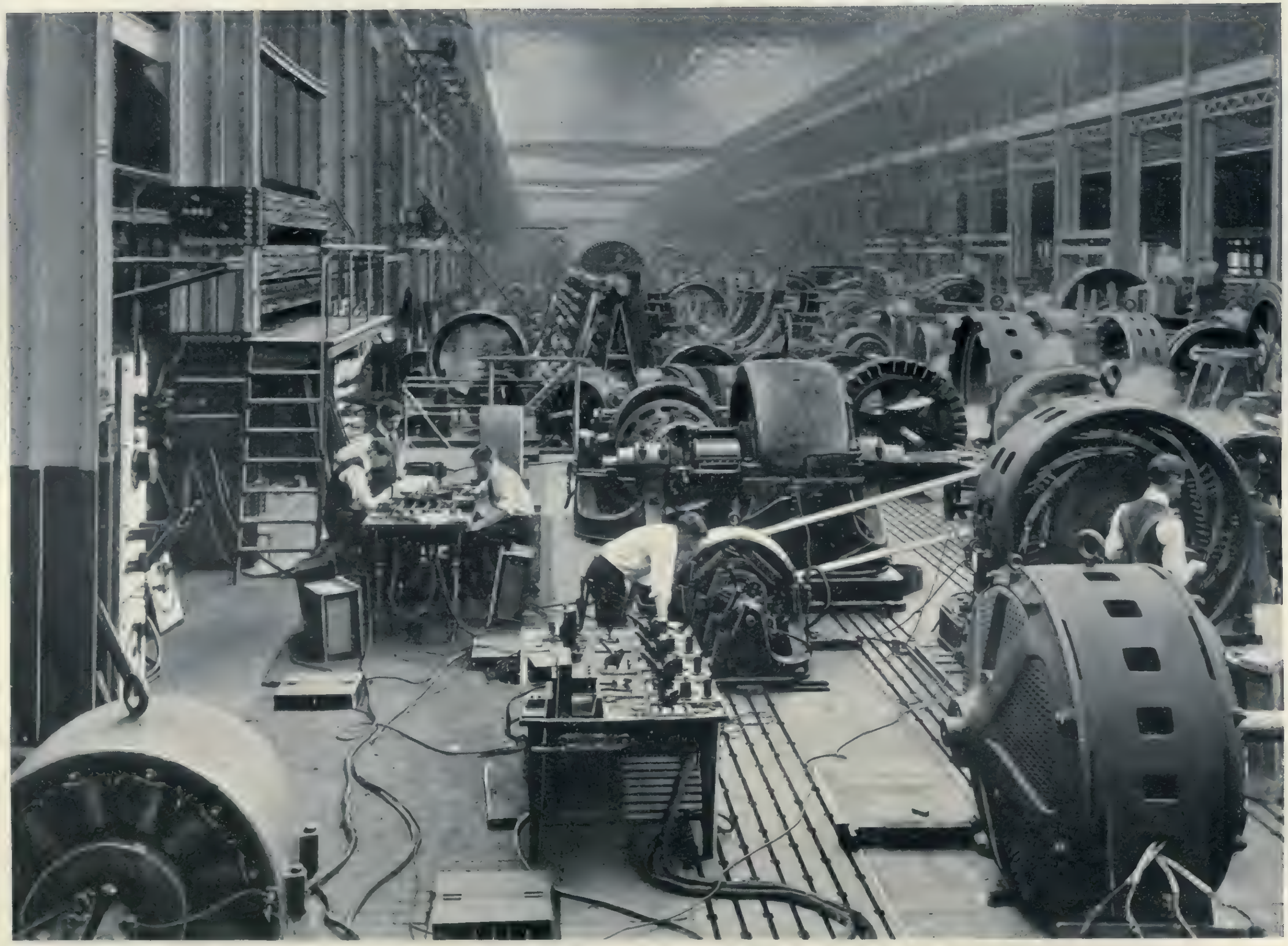
The delegation of the Associazione Elettrotecnica Italiana arrived on the *Princess Irene* and *Deutschland* as early as August 24th and 25th. A separate programme of entertainment for the Italian visitors being arranged and carried out by the local New York committee of the Associazione Elettrotecnica Italiana.

THE WATERSIDE STATION OF THE NEW YORK EDISON COMPANY.

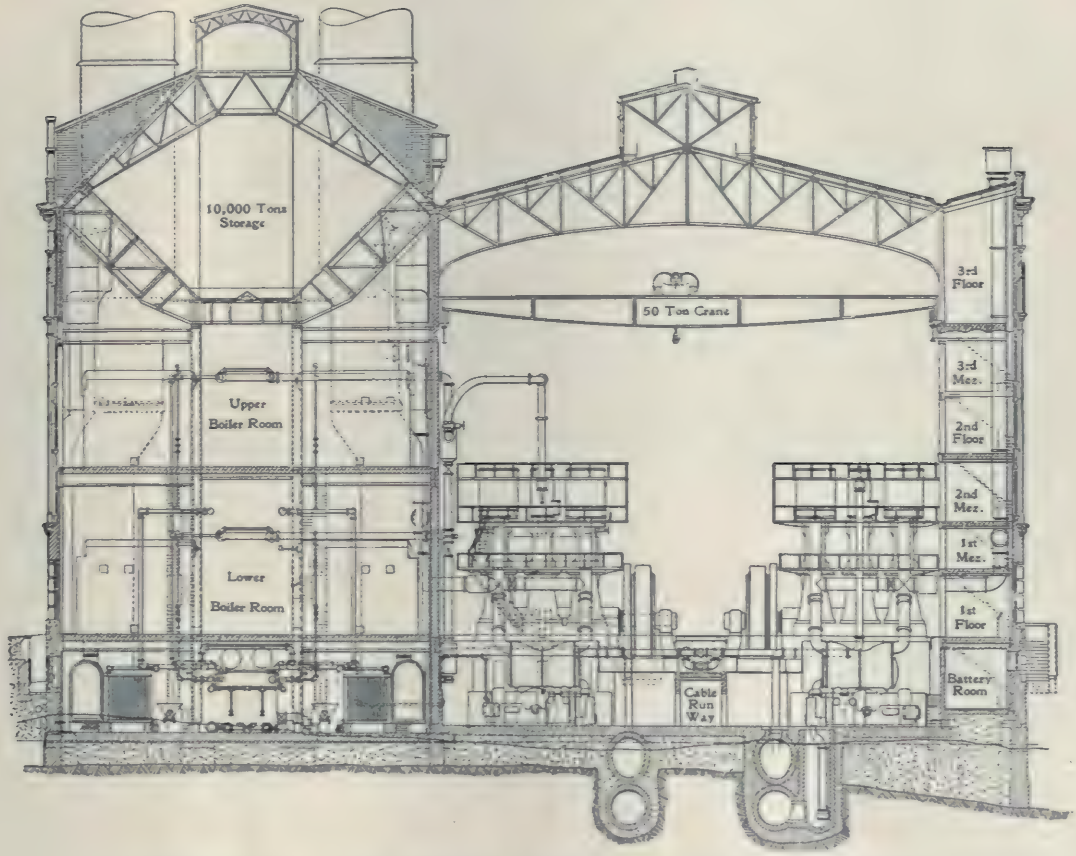
One of the most notable items in the programme at New York was a visit to the Waterside Station of the New York Edison Company. I am indebted to that Company for a very complete description of the Station,



THE WATERSIDE STATION OF THE NEW YORK EDISON COMPANY.
Dynamos and engine-room as seen from the switchboard galleries.



ITEMS ON THE EXCURSION PROGRAMME—WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY'S PLANT, EAST PITTSBURG. PA.
Testing generators and motors.



CROSS SECTION OF THE WATERSIDE STATION.—NEW YORK EDISON COMPANY.

from which the following details have been summarised. As the writer aptly says, "We have in the growth of this great enterprise a review, not in miniature, but on a grand scale, of what the art of electric light and power has attempted and realised in America. Here is a system beginning with but one class of work, and within a very limited area, but now furnishing current for every purpose to which it can be applied, and covering the whole of Manhattan Island.

The problem of furnishing light and power to a large city like New York involves the supplying of the densely populated business district, and also requires that current be transmitted to a large outlying residence district covering many square miles in area, and in the case of New York extending north ten miles from the heart of the city. It is located on First Avenue, covering the block between Thirty-eighth and Thirty-ninth streets, and running to the East River, an area of 272½ ft. by 197½ ft.

The boiler room, a magnificent hall, 76 ft. by 267 ft. 10 in. is separated by a massive brick wall from the main operating room, which is of the same length, and no less than 115 ft. wide, presenting in its lofty pitch and harmonious proportions a strong resemblance to the main aisle of some grand and imposing cathedral.

The 16 general electric dynamo-Westinghouse engine generating sets are placed each on its separate foundation and each with its immediate and switching appurtenances constitutes a "cellular" unit, as though it alone were the generating heart of the station. The features of this interesting and important arrangement will be discussed later. The dynamos all face inward to the central passage-way, their right and left-handed revolution corresponding to their position on the north or south side. The storage battery room is in the basement on the Thirty-Eighth Street side, south, as indicated. Locker rooms, lavatories, etc., are provided in liberal measure for the comfort of the employees. On the Thirty-Eighth Street side, running the full length of the stately building, there are five galleries the upper ones being used for storage, offices, etc., while the two lower ones afford ready access to the upper platforms of the engines. It is impossible not to be struck with the skilful manner in which the designer of this great station, with its ultimate capacity of not less than 125,000 h.p., have pushed along practical lines in these details, the analogy with marine engineering which underlies the ideal of modern central station work. A mere glance at the cross section view shows these galleries, just like the decks of a big steamship surrounding the vast central well or hull within which the steam forces are at their work, while an inspection of the plant itself carries the parallel even further, for at the western end are the switchboard galleries, the full width of the dynamo room, corresponding in by no means a fanciful manner to the "quarter deck," whence command issues and through which all the functions of the system are set in motion and exercised.

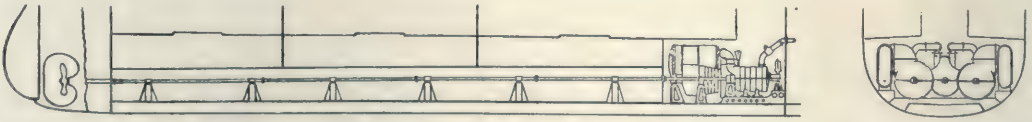
LAUNCH OF THE TURBINE SHIP "VICTORIAN."

THE FIRST TURBINE ATLANTIC LINER.

THE *Victorian*, being the first of the two turbine-driven ships ordered by the Allan line, was launched last month from the shipbuilding yard of Messrs. Workman, Clark and Co., Belfast, and has the honour of being the pioneer turbine vessel for ocean service. She and the *Virginian* (now being built on the Clyde) are sister ships as regards dimensions, capacity, and power. This pair of 12,000 ton vessels will form a notable reinforcement to the fine fleet of the Allan Line, which already numbers twenty-eight steamers, and comprises several vessels of ten thousand tons each engaged in the mail, passenger, and general service between the United Kingdom and Canada. Splendid ships, however, as are the *Bavarian*, *Tunisian*, *Parisian*, and *Ionian*, the *Victorian* exceeds them in size by 2,000 tons, and, as regards speed, is expected to be a long way in advance of them.

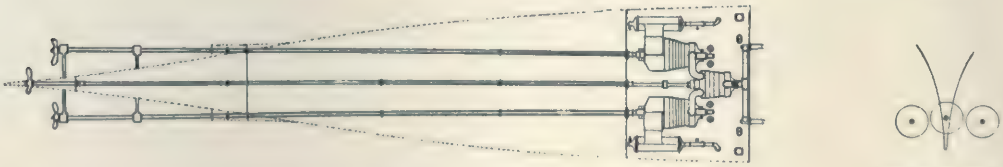
That she is one of the handsomest vessels ever built in Belfast was the opinion of every expert who saw her on the stocks before the launch, or in the water afterwards. She is a striking contrast to the ordinary straight-sided ocean steamer of to-day. Her lines fore and aft are sharp and clean, swelling gracefully into a noble breadth amidships, which suggest high qualities of steadiness and stability, as well as a capacity for speed, which could hardly be excelled. Before she took the water people viewed with interest her three propellers—a novel feature in an Atlantic liner.

It is not, however, her grace of outline nor the promise of perfect internal equipment (which the work already done indicates), that makes the *Victorian* so interesting an object to the shipping world just now. It is her position as the pioneer of a departure which may revolutionise the character of the ocean liner from a shipbuilder's and passenger's standpoint in as great a degree as did the departure which introduced the twin-screw and the five-hundred-footer.



SECTIONAL ELEVATION.

SECTION THROUGH ENGINE ROOM.



PLAN VIEW.

SECTION AT AFT END.

ARRANGEMENT OF THE "VICTORIAN'S" TURBINE MACHINERY AND THREE PROPELLERS.

VIEW IN THE YARD OF MESSRS. WORKMAN, CLARK AND CO., AT WHICH THE "VICTORIAN" WAS BUILT.

For a considerable time it has been debated whether the turbine would be practicable as a means of propelling the giant ships that carry our cross-Atlantic passenger traffic, and while other great shipping companies were looking for more light and hesitating to plunge into a practical experiment that might involve heavy loss, the Allan Company boldly assumed the responsibility of giving the lead. They lost no time either. The keel of the *Victorian* was laid by Messrs. Workman, Clark and Co. ten months ago, and it is expected that before the end of the year she will be ready for sea.

THE DECISION TO INSTAL TURBINE MACHINERY.

Originally, the *Victorian* was designed to be driven by reciprocating engines, but after some progress had been made with her hull, Messrs. Allan decided that she should have turbines instead. Messrs. Workman, Clark and Co. made the necessary alterations in her structural design, and at the same time undertook what was a far more difficult and delicate task, the construction of the great turbines—the largest ever made—which are to drive her. This was by arrangement with Messrs. Parsons and Co., for it was the Parsons' turbine that was decided upon. A high-pressure and two low-pressure turbines will drive the three propellers of the ship, which, by the way, strike one as being unusually small to drive a monster possessing a cargo capacity of more than 8,000 tons, beside accommodation and equipment for upwards of 1,300 passengers. These propellers, however, revolve at very high speed—

AN EARLY STAGE OF CONSTRUCTION.

from 270 to 300 revolutions per minute. The central one, arranged as in a single-screw vessel, is worked by the high pressure turbine, the others, which are arranged as in a twin-screw ship, by the low-pressure turbines. The two latter have each a reversing arrangement, which enables them to be driven full speed astern, either together or independently. Thus the ship will be as easily and effectively manœuvred as regards turning or backing as an ordinary twin-screw. This disposes of the objection which has sometimes been urged against turbines, that they are defective with regard to reversing motion.

PROGRESS OF THE ENGINES.

To see these appliances being made in Messrs. Workman, Clark and Co.'s fine engine works suggests the manufacture of a titanic musical-box or some mechanical toy for the amusement of a giant. The ponderous steel casing and drum of each of the low-pressure turbines (the mass that means strength and resisting power to steam pressure) weighs something like ninety-five tons, while the "blades," moving and fixed, are so tiny and fragile looking that the contrast is remarkable.

The manufacture of the turbines is well forward. Messrs. Workman, Clark and Co. have a special engine shop, equipped with the necessary plant devoted to them, and Mr. C. E. Allan, one of the members of the firm, personally superintends their construction. It will, however, require some weeks longer of skilful and arduous labour before the turbines are ready to be fitted in the *Victorian*.

HYDRAULIC RIVETER AT WORK ON CENTRE LONGITUDINAL.

ACCOMMODATION.

Thanks to the economy of space which is such an important feature of the turbine system, the builders have been able to provide accommodation on board the *Victorian*, such as is probably not to be equalled by any vessel of her size afloat. They have utilised the saving, not to increase the number of passengers carried, but to give every possible comfort and luxury to all three classes of passengers. The *Victorian* will be emphatically a comfortable ship, so far as the perfection of appointment can make her so. The first-class accommodation, which, as usual, is amidships, is of the most complete and approved order. Perfectly heated and ventilated state-rooms and suites of rooms, a spacious and well-fitted dining-saloon, an elegantly-appointed

MESSRS. WORKMAN, CLARK AND CO.'S SHIPBUILDING YARD—THE FRAME BLOCKS.

As regards facilities for the handling of cargo, the ship is as adequately fitted as possible. She has no less than ten steam winches and derricks for working the holds and she is provided with insulated chambers and refrigerating plant so as to enable her to carry fruit, dairy produce, etc., from Canada.

music-room, and a luxuriously equipped smoke-room are some of the features. Not less comfortable, proportionately, are the second-class quarters. Care for the steerage passengers, which has always been a leading point of policy with the Allan Line, is exemplified in a remarkable degree. Even in their unfinished condition the music-room, dining-room, and other special accommodation for this class challenge admiration for their roominess and completeness of equipment.

Electric light throughout, a complete printing outfit, and an installation of Marconi's wireless telegraphy, are among the arrangements for the comfort and convenience of passengers.

The steam to drive the turbines will be generated by eight large boilers of the usual type, which are being made in Messrs. Workman, Clark and Co.'s boiler-works.

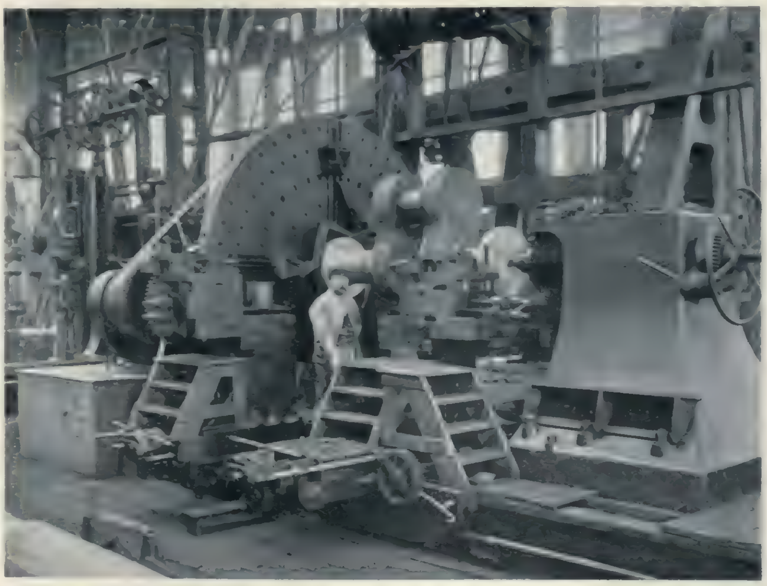
DIMENSIONS.

The length of the *Victorian* is 540 ft.; her breadth, 60 ft.; her depth, 40 ft. 6 in. She is divided by bulkheads into eleven compartments, and with the subdivisions of her double-bottom, she has twenty watertight spaces. She is built to the highest class of the British Corporation Registry of Shipping, and her hull has been specially strengthened above the requirements of the Corporation in order to make her doubly secure against the heavy weather of the North Atlantic.

AN EXPERIMENTAL SHIP.

The *Victorian* is largely an experimental ship. Turbines have proved a success for small high-speed channel steamers, but whether they will be an equal success for ocean steamers remains to be proved. The trial trip of the *Victorian* will practically solve this problem, which has been agitating the minds of shipping men for some time past. Whatever the result may be, therefore, with the Allan Line rests the honour of leading the way with an important economical venture, and with Messrs. Workman, Clark and Co., Ltd., that of conducting a new departure in shipbuilding and engineering science.

For the above particulars and illustrations we are indebted to Messrs. Workman, Clark and Co.



IN THE ENGINE SHOP.

ILLUSTRATED NOTES.

Elevating, Conveying, and Storage Plant.

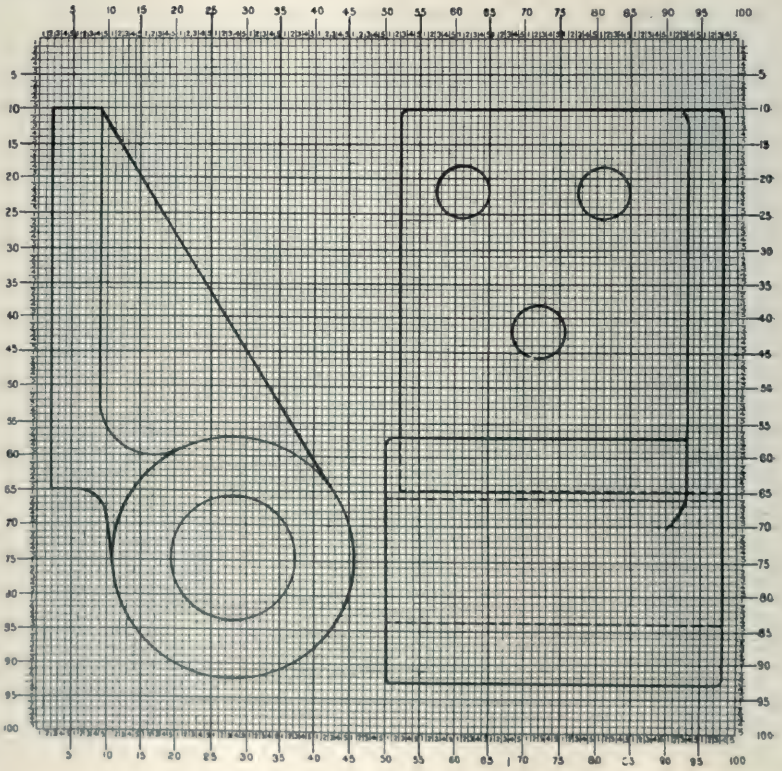
THE largest installation of inclined retorts in the world was carried out some time ago at the gas works of the Corporation of Edinburgh and Leith, the cost being £113,000. Messrs. Graham, Morton and Co., Ltd., of Leeds, who executed the work, have now in hand a further contract for the supply and erection of coke elevating, conveying and storage plant for water tube boilers, and water gas plant at the same works. The plant consists of two 12 in. continuous bucket-elevators of the cased-in type, with 38 ft. centres, provided with receiving hopper and delivery shoot. Two 15 in. push-plate conveyors, 121 ft. centres; a storage bunker for supplying the producers of the water-tube boilers with fuel; two storage hoppers over water-gas generators, the former provided with outlets, slides, and measure-chamber, and travelling hopper and shoot for filling the producer, the latter is provided with outlets and slides only. In both cases the slides are actuated by hydraulic rams.

A Telephone Sketching Chart.

An ingenious telephone sketching chart has been designed by Messrs. W. T. Glover and Co.'s work's engineer to overcome the difficulties experienced in transmitting information which cannot be clearly explained by telephone in the ordinary way. It will be seen from the accompanying illustration that any design can readily be transmitted and understood by the use of the chart, where merely verbal detail telephoned would result in confusion, the delay in dispatching by post being thus avoided. Instructions for using the chart, which has been copyrighted, are printed at the foot.

Destructor Plant for Lorenzo Marques.

The Horsfall Destructor Company, Ltd., received in May of this year a telegraphic order for a complete Destructor Plant for the City of Lorenzo Marques, Delagoa Bay, eight weeks only being allowed for the delivery of the plant, which included destructor cells, dustcatcher, steel buildings, steel chimney, boiler, etc. The whole plant was placed on board one steamer at Liverpool within the specified time, and is now in process of erection at Delagoa Bay.



THE "S.S." TELEPHONE: TABLE PATTERN.

The "S.S." Telephone System.

The General Electric Company, Ltd., draw our attention to their new "S.S." Secret Service System of intercommunication telephone. The instrument has been designed with the special object of maintaining absolute secrecy while any two persons are in communication with each other, a system which makes it impossible for a third person to overhear or interfere with telephonic conversation. We are informed that the method of wiring ensures perfect freedom from current leakage to earth, as all circuits are metallic throughout. Indicator "drops" have been added in order to show whether any one has rung up during the time that a person may be away from the office. The number of the line is also shown, thus indicating the person who desired to enter into communication. The method of making connection is the same as employed at telephone central stations, by means of "jacks." Another feature of this British-made telephone is that it is impossible to leave the instrument out of call.

Institute of Civil Engineers—Awards.

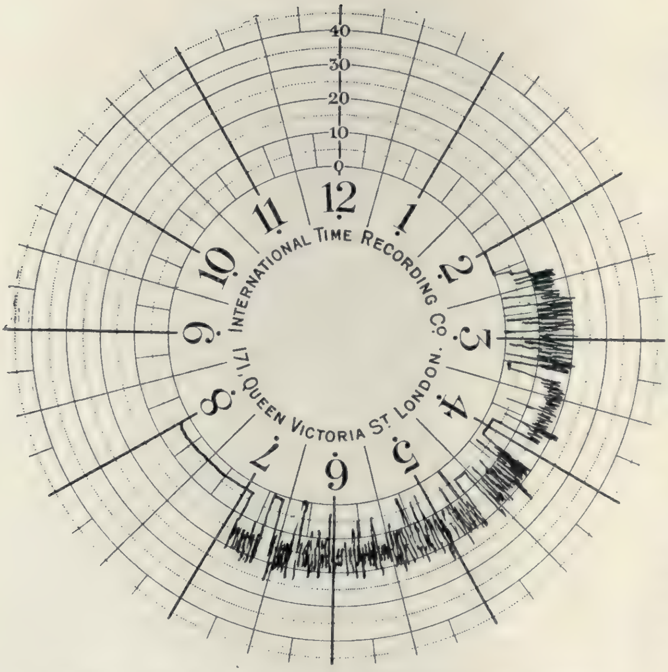
The council of the Institution of Civil Engineers have, in addition to the medals and prizes given for communications discussed at the meetings of the institution in the last session, made the following awards in respect of other papers dealt with in 1903–4: Telford premiums to Arthur Hill, C.I.E. (Bombay), F. A. Hurley (Cairo), E. M. De Burgh (Greystones), H. H. Dare, M.E. (Sydney, N.S.W.), William Marriott (Melton Constable), T. G. Gribble (London), W. H. Haigh (Cardiff). For students' papers the awards are:—A. Miller scholarship, tenable for three years, and the James Forrest medal to C. W. L. Alexander, B.E. (Birmingham); Miller prizes to J. M. Clark, M.A., B.Sc. (Glasgow), L. G. Crawford (Barrow-in-Furness), W. H. Dickenson, B.Sc. (Jesmond-on-Tyne), William Lawson (Newcastle-on-Tyne), C. G. Du Cane, B.A. (Middlesbrough), C. Gribble (York), J. E. Lister (Sheffield), J. M. Kennedy (London), H. Middleton (Newcastle-on-Tyne), J. D. Morgan (Handsworth).

New Recording Apparatus for Motor Vehicles

We illustrate two new appliances by the International Time Recording Company, of 171, Queen Victoria-street, E.C., of special interest to the owners of motor-vehicles. The first, called the journey recorder, is a small instrument which can be attached to a motor wagon, van or dray, and produces a record of the day's journey of the vehicle, showing the time of starting, the duration of all stoppages on the road, the time of returning home, and the total number of miles travelled. A paper dial marked with the hours of the day is rotated by a clock, and a pencil, actuated by the wheel of of the vehicle, draws a short line for each mile travelled, on the completion of the mile the pencil is returned and the mile recorded. When the vehicle is standing the pencil marks a concentric line. The gear for actuating the pencil is very simple, being a scroll fixed on the nave of the wheel, and gearing into a star wheel attached to the axle or spring, and by a flexible shaft inside a protecting tube, transmitting the motion to the recording mechanism. This machine thus provides a means of extending the system of mechanically checking employees' time, to those who are at work on the road, and over whom it is otherwise impossible to exercise supervision. It is of great service to owners of heavy motor vehicles which are doing haulage work on contract.

SPEED RECORDER BY THE INTERNATIONAL TIME RECORDING COMPANY.

The other machine is a combined speed indicator and recording clock for use on motor-cars. The indicator shows on a dial the speed in miles per hour, and is driven by substantial gearing consisting of worm and worm-wheel, cog-wheels, and shaft in such a way that there can be



RECORD OF A FOUR HOURS' RUN ON A MOTOR-CAR.

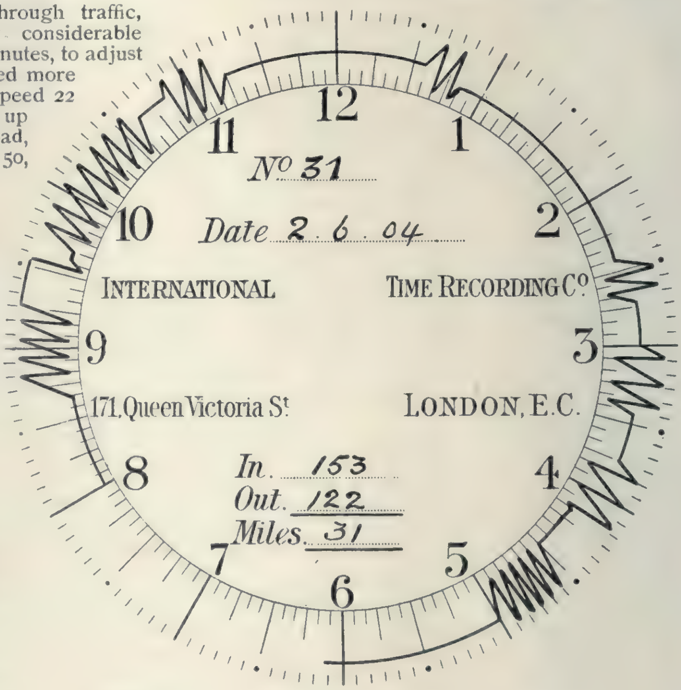
READING : Started at 2.15 p.m., running through traffic, causing many stops, and consequently considerable variations of speed ; stopped at 3.20 for 5 minutes, to adjust motor ; 3.25 to 3.50 running in country, speed more regular, 16 to 18 miles per hour, highest speed 22 miles ; stopped at 3.50 for 15 minutes, to fill up water tank ; 4.5 to 5.50 running on hilly road, highest speed 25 miles per hour ; 5.50 to 6 50, returning home through traffic.

no slip or irregularity due to wear, etc. The principle of the indicator is that of counting the number of revolutions of the road wheels during a fixed period of time ; this brings the pointer on the dial to its proper place, where it is held until the next indication takes place, when, if there has been any variation in the speed, the pointer takes its new position. The whole action, therefore, is quite positive, and does not depend on centrifugal force in any way. The recording clock rotates a paper dial, on which the time is marked by radial lines, and the speed by concentric circles ; motion from the indicator spindle is transmitted to a pencil which works radially over the dial and marks on it the varying speeds by radial lines, and the duration of all stoppages by concentric lines. This will give the motorist a most interesting record of his various runs, and show the capabilities of his car. It will also be of value in the case of cars let on hire, and as a check on the driver when not accompanied by his master. There is no need to carry a separate clock as this recording clock shows the time of day.

Society of Engineers.

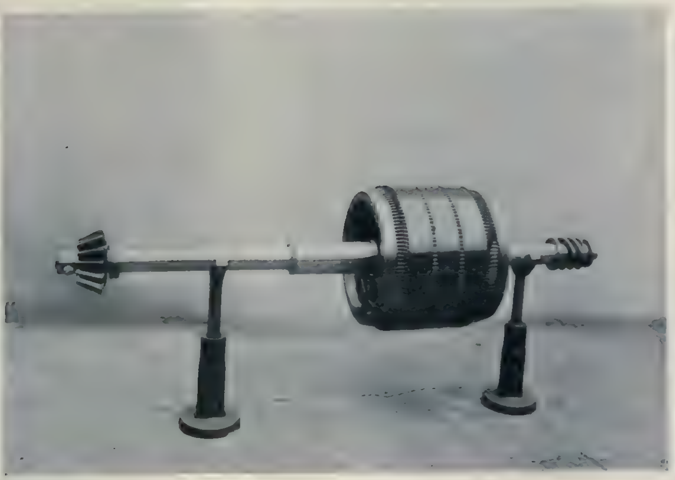
The present year being the Jubilee of the Society of Engineers, the Council have decided that this epoch in the Society's history shall be suitably celebrated. A conversazione is therefore being arranged for the evening of November 16th next, at the Royal United Service Institution, where the Society's ordinary meetings are held. On this occasion the Museum of the Institution will be thrown open to members and their friends, including ladies.

Arrangements were made, by permission of Messrs. John Broadwood and Sons, for the Members and Associates of the Society and their friends to visit on the 21st ult. their Pianoforte Factory at Stour Road, Old Ford. The manufacture of Pianofortes in every stage, proved of considerable interest, the machinery employed being driven electrically. The visitors were shown a collection of instruments dating from the earliest times, and illustrating the evolution of the modern pianoforte.



RECORD OF THE DAY'S JOURNEY OF A VAN.

READING : Started out at 8.40 a.m. ; travelled 12 miles with 2 short stoppages, till 10.35 ; standing from 10.35 till 10.50 ; travelled 3 miles, till 11.15 ; standing, 11.15 till 12.35 ; standing, for dinner, from 12.50 to 2.25 (too long) ; travelled 14 miles, with 3 stops, and reached home at 5 p.m. ; the last 6 miles were done in 30 minutes, which is too fast, considering the length of the journey.



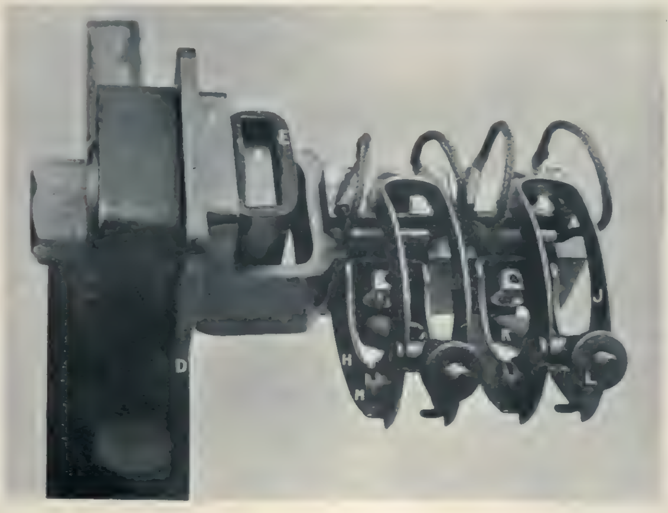
SHORT-CIRCUITING ROTOR FOR THREE-PHASE MACHINE.

The "Universal" Patent Brush Gear.

In the "Universal" Patent Brush Gear for Continuous Current Machines, which we illustrate by the courtesy of Messrs. Mavor and Coulson, Ltd., the designers, while ensuring continuous metallic contact between brush and brush holder, have provided for the lightest brush practicable, and its easy detachment from the holder for examination or renewal. At the same time they have kept in view the following desiderata: small inertia and easy adjustment of the regulating and holding up gear; radial position of the brush, relative to commutator and efficiency for either direction of rotation; freedom from insulated parts exposed to contact to the body of the machine; adaptability to various classes of machines. A set pin passing through the rocker or brush holder carrier is uninsulated from the rocker and insulated from the brush box "C" by means of a washer and sleeve "D" and a cover "E" for the nut "F" into which the set pin is screwed. The brush box "C" is provided with a slot in the shoulder so as to permit of radial adjustment to take up wear of the commutator or to adjust for difference in diameter. The copper-plated brush "G" has soldered to the top of it a contact plate carrying a soft flexible conductor soldered into the lugs at its corners, and in the body of it is clamped a copper contact plate for making contact with the brush box "C." This plate is clamped up between the spring bracket "H" and the brush box "C" by means of a set pin "I." Pressure is brought to bear on the top of the brush by a finger "J" held in position by spring "K" with adjusting screw and nut "L." The hinge between the bracket and finger is formed by a stud "M" with two grooves, one for the bracket and one for the finger. One of these grooves is closed over the finger securing the stud in place. The bracket "H" and finger "J" are attached to the brush box by a single screw, the set pin I, by means of which the brush can easily be removed from the holder for inspection or renewal. This gear is to be had from Archibald Campbell, Esq., 27, Chancery Lane, London, E.C.

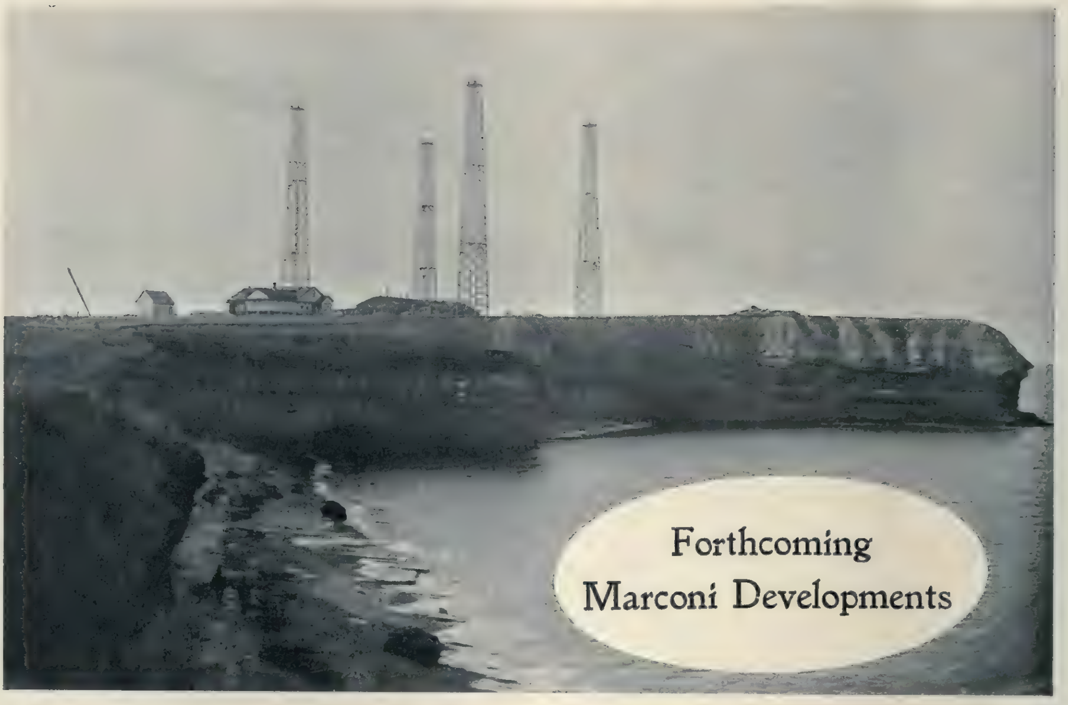
Short-Circuiting Rotor for Three-Phase Machine.

This invention, which is a product of the same firm, has reference to alternating current electric motor armatures carrying embedded short-circuited conductors of high conductivity metal. In such armatures as heretofore constructed with embedded lengths of high conductivity metal united at their ends to common conductors, it has been found difficult, if not impracticable, to provide such electrical and mechanical connection between these lengths, and the common conductors uniting them electrically and mechanically at their ends, as would not cause, either at first or ultimately, the production of detrimental resistance. In order to obviate this disadvantage the lengths of high conductivity metal are, according to this invention, united and electrically connected by high conductivity metal fused to or fused and run upon their ends. This fusion between the lengths and common end connections might be effected electrically, but it is preferred to first melt the metal which is to constitute the common connection and then to cast the melted metal upon the projecting ends of the before mentioned lengths, while the armature is held with ends of the lengths in the channel of a mould such as may be made up with rammed sand.



THE UNIVERSAL PATENT BRUSH GEAR.

Forthcoming Marconi Developments



MARCONI STATION AT CAPE BRETON.

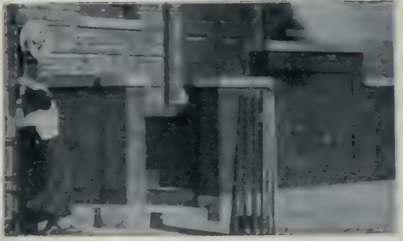
IN the course of his most recent remarks on advances in space telegraphy Mr. Marconi is for obvious reasons somewhat reticent as to technical details pending completion of his patents, but he is able to state some very satisfactory results. These may be summarised as follows :—

" We have now," says Mr. Marconi, " an instrument whereby we may transmit overland with as great facility as over water. We have demonstrated this practically to the entire satisfaction of British naval engineers by sending continuously from day to day, from the station at Poldhu, Cornwall, to the station at Gibraltar. The land in this instance presents unusual difficulties and obstacles, being extremely mountainous ; yet messages were clearly and distinctly exchanged on all occasions and under all conditions."

Mr. Marconi goes on to announce an important increase in the speed of transmission : " With the old forms of instrument we were practically limited to twenty words a minute. By the new apparatus this is increased 50 per cent. to thirty words a minute without difficulty." He records that it is possible to keep constantly in communication with either shore of the Atlantic throughout an entire passage across, as was proved by his experiments on the *Lucania* during a recent voyage to America. About two hundred words a day were received from the Poldhu station until within about a day's run from New York, when communication was " picked up " with the local shore station at Nantucket. Mr. Marconi advances the vastly important claim that he has now an instrument which may be so attuned that it will receive messages either independently or in concerted pitch with all other installations on board transatlantic steamers. Another advantage connected with the most recent apparatus is, that it obviates the use of much of the cumbersome aerial gear found necessary with the perfect operation of the coherer system. As to transatlantic service Mr. Marconi will not make any statement as to the probable date of its opening for public service, though he says definitely enough : " There is no doubt about the practicability of the transatlantic commercial service ; it will be accomplished soon." He is not ready to make any predictions on the subject, but goes on to say : " We have, can, and do exchange service messages, private signals and cipher despatches with both the Cape Breton and Cape Cod stations. For the present my time is devoted to the development and standardisation of the new marine service instruments and the instruction of operators in their use." Another interesting result concerns the life-saving possibilities of space telegraphy. Says Mr. Marconi : " It is possible now, with these instruments, when ships are coming dangerously close, to tell approximately how far they are apart, to calculate the rate of their approach and thus to avoid collision. The direction of their approach is not to be accurately determined ; but with an improvement on which I have done some work, even this will be possible. I am able to direct a wireless message so that it will travel for, say, ten miles in a given direction without spreading over a large space. I hope to be able to exceed that limit of distance somewhat, but this will be ample for the protection of marine craft. To be able to direct their signals, positively, will be to enable them to accurately determine the relative position of approaching craft, even though each has lost its reckoning."

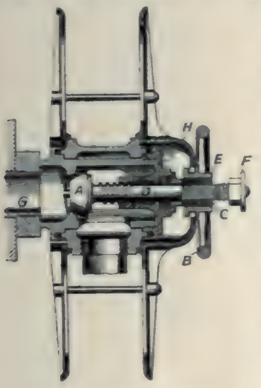
In addition to the ordinary service for passengers' messages from ships to shore, which the Company has been carrying on for more than three years, there has recently been inaugurated a service of weather reports for the *Daily Telegraph*, which show the state of weather on the Atlantic some hours earlier than could be shown by other means. These afford, it is thought, valuable assistance in preparing meteorological forecasts. Within the last few months there has also been inaugurated a daily service of news messages to ships throughout the whole of the Atlantic passage.

For the interesting portrait which we have used as the frontispiece of this number, and also for the above illustration, we are indebted to Marconi's Wireless Telegraphy Company, Ltd.



An Ingenious Automatic Fire Hose Reel.

IT goes without saying that the supreme and first demand to be made on fire appliances is the rapidity with which they can be put in action. Almost as important is simplicity of construction and infallibility of action. A good fire prevention device must act instantaneously in the hands of any inexperienced person, and there should be no risk of losing precious moments through the uncertainty what to do next. For these reasons we welcome the new automatic hydrant which has been designed with special regard to the conditions named, and has been put on the market under the name of the "Cliff Patent Automatic Fire Hose Reel," by Mr. E. Zappert, of 27, Chancery-lane, London, W.C.



SECTION OF REEL.

Our illustrations, taken with the aid of the mutoscope, clearly show that the device, which occupies very little space, cannot be tampered with, and is always ready for use. It consists of a reel, on which the hose is wound, directly joined to a main or service pipe inside or outside the building. The hub of the reel being at the same time the stem of the valve, runs out the empty hose automatically, and gradually turns on the water, so that taking hold of the mouthpiece and running towards the flames is all that is required. Only eight seconds passed between the first and the third picture (distance 50 ft.).

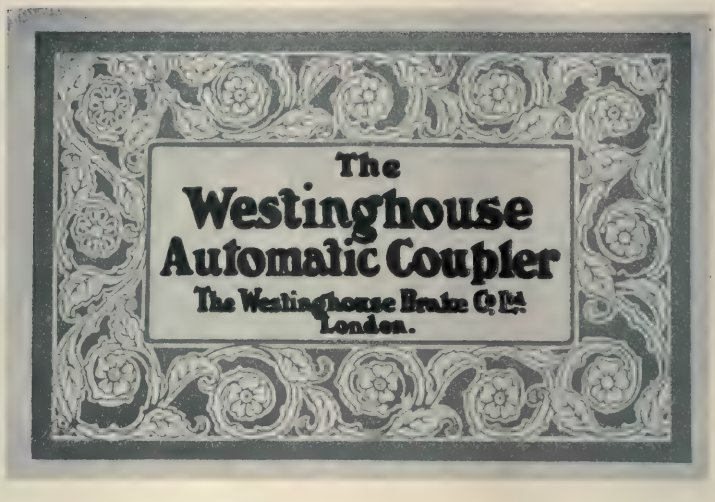
The saving of time against the ordinary hydrant necessarily must be a very considerable one, and expert handling, keys, spanners, directions for use, encasing of hydrant, and the like, become superfluous, since any factory girl, hotel waiter, hospital nurse, gardener, etc., can handle the apparatus easily. The merits of this ingenious appliance have already been endorsed by a number of architects, municipalities, factory owners, and private individuals in this country. The invention had its origin in the United States, where, we understand, it is largely used.

The most important features of the mechanism are indicated in the annexed diagram showing the reel in a normal condition with the valve A closed. On perceiving a fire the nearest person will seize the nozzle at the end of the hose and run towards the fire, this act resulting, of course, in the unwinding of the hose from the reel. The rotary motion of the latter is communicated to the hand wheel B, and by the latter to the sleeve C, the said sleeve turning freely upon the valve stem D and travelling outward upon said stem and from within the hub of the wheel B, but not affecting or rotating the valve stem until a given amount of the hose has been unwound from the reel and the sleeve has passed into engagement with the nut F. Upon this the continued rotation of the reel, hand wheel, and nut, will, through the rigid nut F, cause the valve stem to rotate and the valve A to open.

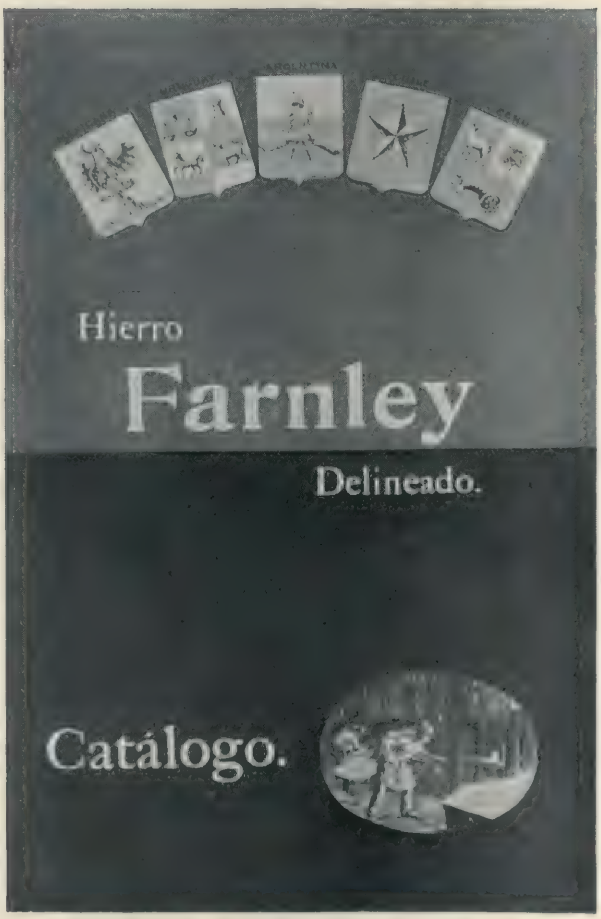
It will be seen that the valve is automatically opened and the water turned on when the hose is fully unwound, while at the same time the unwinding of a *few* turns by mischievous or ill-disposed persons will not result in turning on the water. The water is shut off by means of the hand wheel B or optionally at the nozzle.

THE NEW HOSE REEL IN USE.

CATALOGUE COVER . . DESIGNS. .



The
Westinghouse
Automatic Coupler
The Westinghouse Brake Co Ltd.
London.



Hierro
Farnley
Delineado.
Catálogo.

The Westinghouse Automatic Coupler.

THE construction and use of the Westinghouse Automatic Coupler, Draw-bar and Buffer, for railway work, are fully described and illustrated in this neat pamphlet, which is clothed in a grey cover, the title standing out boldly in glazed red ink while the lettering is edged with black. The pamphlet is tied with a red silk cord. It has many illustrations of interest to railway men. Says the writer: "It is obviously essential that any apparatus of this kind should be so designed that it can be fitted to, and employed on, vehicles having the usual hook coupling and side buffers; and also that vehicles so equipped should be able to be used in a mixed train, and coupled without difficulty to others fitted only with the hooked draw-bar and side buffers at present in use. The appliance described meets these conditions.

A Catalogue for Abroad.

A very striking design is that employed for the cover of the Spanish catalogue issued by the Farnley Iron Company, Ltd. Our illustration scarcely does justice to the cover, owing to the fact that it offered exceptional difficulties to the photo engraver, the top half being a brilliant red, and the lower part a bright blue. The various coats of arms are those of the South American countries doing business with the firm, while in the lower right hand corner an illustration of the puddling process has been introduced with excellent effect. The title of the catalogue is rendered in white, and can be read at a distance.

It may be added that the numerous half-tone blocks illustrating the text, although for most part small, are excellently rendered. Many of the illustrations are attractively printed in colours while each type page is enclosed in a red line border. The production is one that does considerable credit to the firm.

Portable Steam Engines of To-Day.

BY

J. C. R. ADAMS.

The previous articles of the series appearing in the July, August, and September numbers, were devoted to a theoretical and practical consideration of single-cylinder locomobiles. In the present and concluding instalment, Mr. Adams proceeds to a consideration of the leading makes of compound portable engines.—ED.

COMPOUND PORTABLE ENGINES.

IN the last article of this series, the writer was enabled, by the courtesy of the respective makers, to bring together a series of examples of the leading types of single-cylinder locomobiles, of up-to-date manufacture, the collection exhibiting in a high degree the qualities of simplicity and directness which have always characterised British-built engines of this class.

Power upon wheels is such a desideratum that it is not surprising to find the portable engine, once an exclusively agricultural machine, regularly adopted for industrial purposes, with the consequence that in dimensions, no less than in mechanical efficiency, it has developed "out of all knowledge," as witness the 200-h.p. engine illustrated in our last article.

The process of evolution which has culminated in the compound portable engine, has undoubtedly been through the double-cylinder class. Locomobiles with two equal high-pressure cylinders have been in use for very many years —in fact, a double-cylinder engine on wheels is recorded among the exhibits entered for the Royal Agricultural Society's Show so long ago as 1847. The use of two-cylindered engines was expressly discouraged by the Society, on the ground of complexity—and rightly so, for the small powers then in use. Large sizes, however, being speedily called for, the double-cylinder came to the front again, and until the year 1879 was universal for engines of anything above 12 or 14 n.h.p. In that year, Messrs. Garrett, of Leiston, introduced the compound principle for portable steam engines, and thus gained the credit of initiating a remarkable improvement. Their experiment in this direction proved successful, and the compound portable soon became established as a standard production by most of the leading makers.

There is a good deal of misapprehension amongst users of steam power and others as to the relative values of compound and simple single or double-cylinder engines, and occasionally claims so extravagant as to defeat their own object are put forth by those who ought to know better.

COMPOUND ENGINES A QUESTION OF ECONOMY.

We will here do our best to give a plain answer to a plain question—What is there in a compound engine—speaking now of portables and their allied types—to make up for the increase in first cost and maintenance, for the additional weight and complication, and for the extra risk from higher speeds and higher steam pressures? There is only one answer to such a question—Increased economy, a better result per pound of fuel used.

In determining therefore whether, under given circumstances, it is, or is not, worth while to purchase a compound engine, in preference to a simple, whether single or double cylinder, practically the only consideration will be the cost of the fuel, the difference in the first cost of the two engines being in comparison almost negligible.

This seems, at first sight, rather a strong assertion, but let us examine it further. First, as to fuel consumed. Starting with the purely practical side of the question, and referring the reader to any of the numerous excellent text books on the subject for the theoretical proof, we may define the consumption of fuel in the two cases of equally well-designed simple and compound portable engines as represented by the figures 35 and 25 per b.h.p. respectively, a saving of ten in every thirty-five, or 28·6 per cent. This is our own experience.

Mr. Walter Hutton, in his carefully collected "Tables of Economic Performances" of various kinds of steam engines, gives 27·8 per cent.

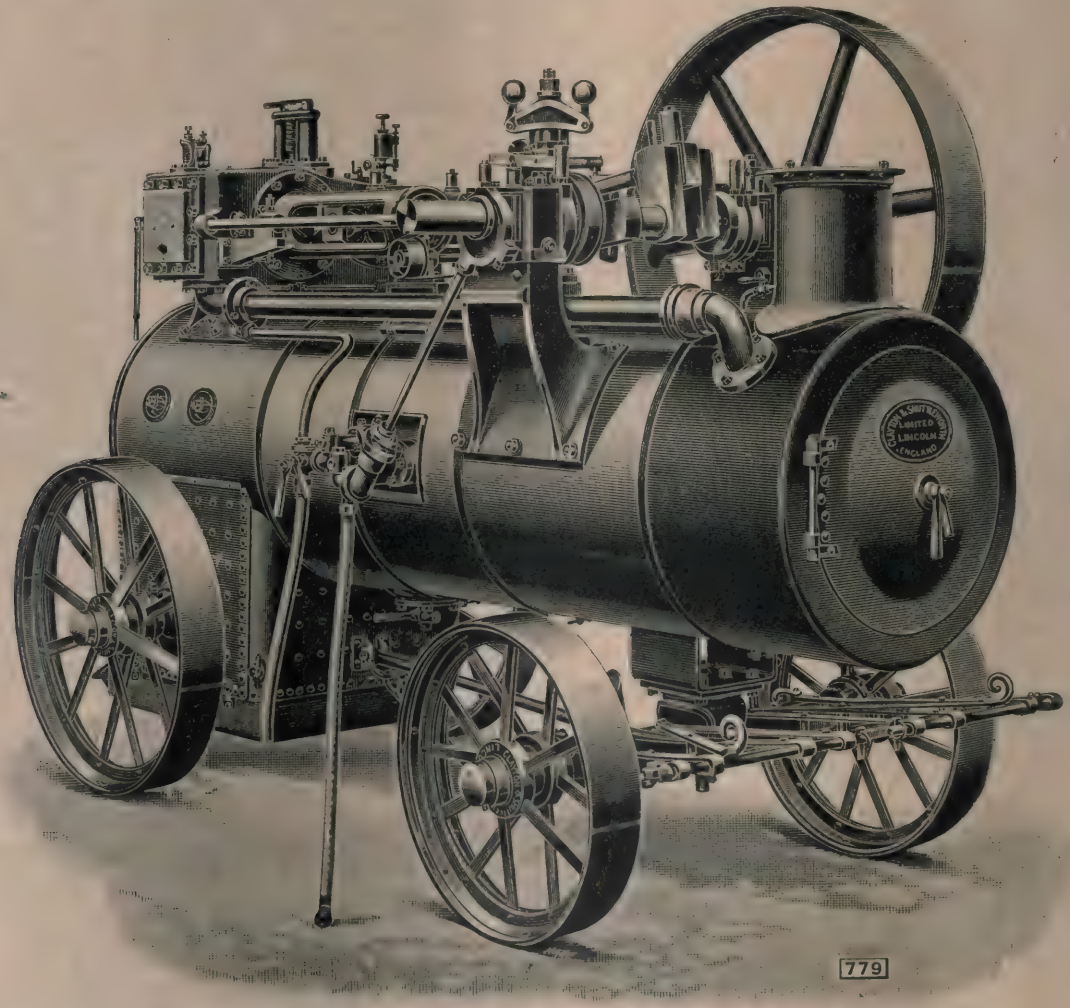


FIG. I. MESSRS. CLAYTON AND SHUTTLEWORTH'S (LTD.) COMPOUND PORTABLE STEAM ENGINE, WITH AUTOMATIC EXPANSION GEAR.

Finally, the average saving as collated from the various figures supplied by the makers of the engines we are illustrating amounts to 29 per cent. Now, if we take the mean of all these, we get a figure of 28½ per cent. in the actual saving.

Basing our calculation on 100 b.h.p. ten hours daily for 300 working days per annum, we have as the cost for fuel of a well designed non-compound engine and boiler, using 4·375 lb. of coal per b.h.p. per hour, say 586 tons per annum at 12s., or £351 12s ; 28½ per cent. saving upon this amounts to the respectable sum of almost exactly one hundred pounds a year. In other words, with coal at 12s. per ton, one can save £1 per annum upon each b.h.p., by compounding.

Water also generally costs something ; the amount of water saved is nearly proportional to that of the fuel ; but we may set this against the additional cost for oil and consumable stores, and the greater wear and tear from the higher speed and pressure employed. It is impossible to pin these latter items down to any definite figures, as the cost of water may vary from next to nothing, where it is raised from a well on the premises, or drawn from a river, up to a considerable sum where supplied

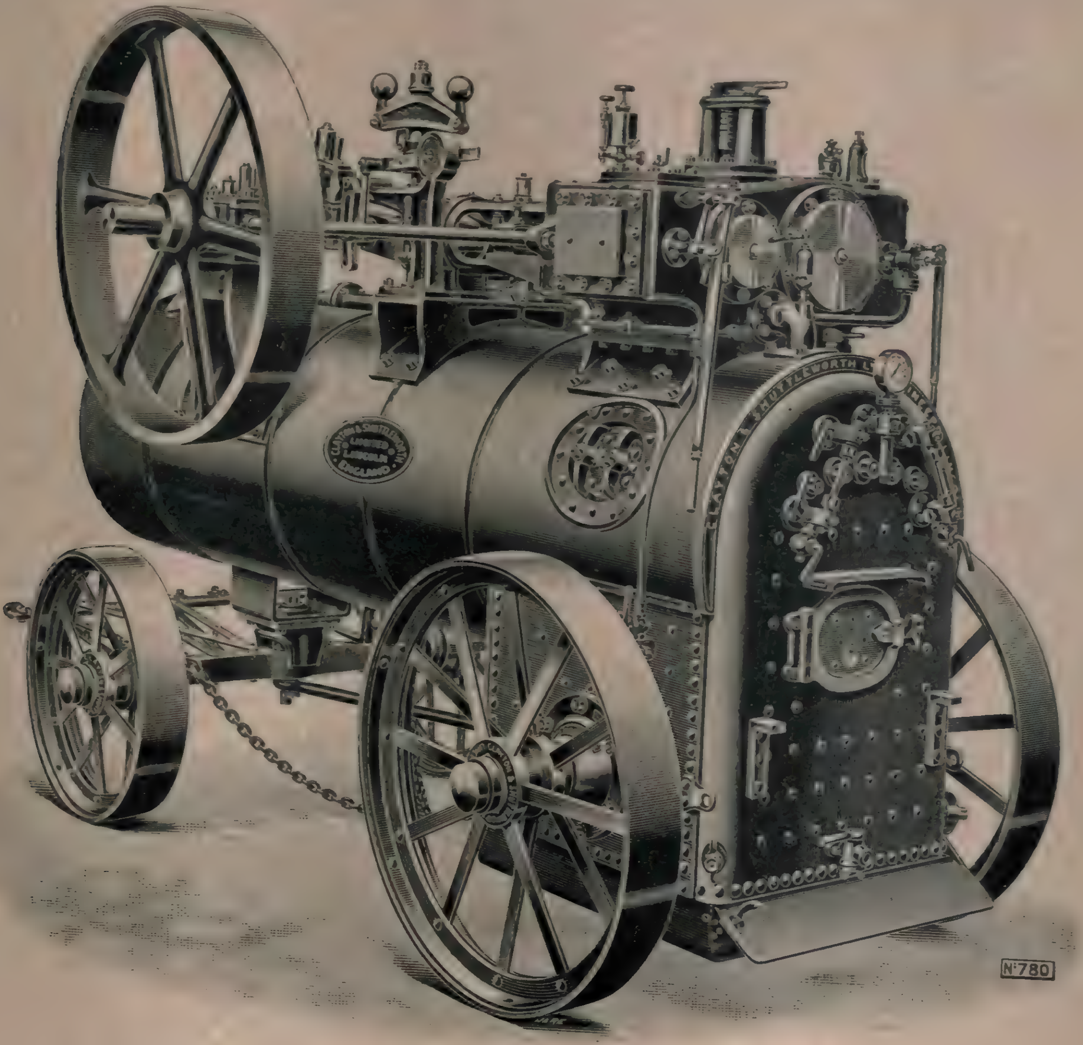


FIG. 2. ANOTHER VIEW OF COMPOUND PORTABLE STEAM ENGINE.
(Messrs Clayton and Shuttleworth, Ltd.)

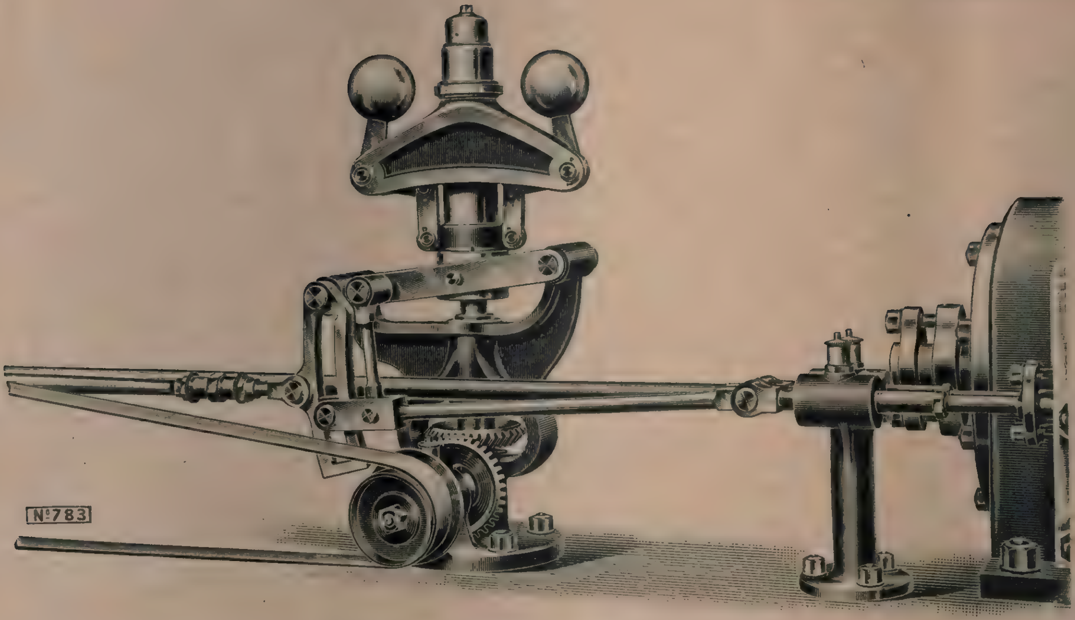


FIG. 3. AUTOMATIC EXPANSION GEAR.
(Messrs. Clayton and Shuttleworth, Ltd.)

from the town mains. In the former case, where a plentiful supply exists, a condenser may be added, which will still further reduce the coal bill, from 15 to 20 per cent.

In view of such an economy in fuel as is here presented, the statement that the extra first cost of the higher-class engine is almost negligible, is, we think, fully sustained.

There are, of course, circumstances in which on one would think of employing a compound engine. In the case of a saw-mill, for instance, where the cost of fuel may be considered as little or nothing, or in small sizes, when the saving effected, though relatively proportionate, is actually small.

Roughly speaking, the difference in cost as between a double cylinder high-pressure portable engine, and a compound or high-and-low pressure engine of equal effective power, averages 26 per cent., which cannot be regarded as an extravagant addition to the first cost, considering the advantages it secures.

COMPOUND PORTABLE ENGINES COMPARED.

Now we may proceed to consider the various makes of compound portable engines which British manufacturers have to offer. In making comparisons, the nominal horse-power should be disregarded entirely, and only the effective or brake horse-power considered. Again, most makers give two effective horse-powers: the lower as representing the normal or daily load, for which their engine is suitable; the larger figures denoting the "occasional" or emergency load, in other words the maximum power available for short periods.

Messrs. Clayton and Shuttleworth manufacture their compound portable engines in sizes from 25–30 to 75–90 b.h.p., in accordance with the annexed illustration, from which it will be seen that the flush-topped boiler (working at 140 lb. pressure) is strongly stayed by five longitudinal bolts, and fitted with a steel manhole cover. The various cast-iron brackets upon which the engine is mounted, are secured to the boiler shell by bolts, as in their single-cylinder engines; two steel stay-rods uniting cylinder and crank bearings, with the provision for sliding as previously illustrated. Both the high and low pressure steam chests are outside (*i.e.*, not *between*) their respective cylinders, and are consequently perfectly accessible for re-facing the valve surfaces when required, an advantage by no means to be overlooked.

On the other hand, the additional width

between the bearings arising from this arrangement seems to call for a central bearing to the crank-shaft, for which we observe there is just room between the two cranks.

Messrs. Clayton and Shuttleworth's automatic expansion gear on Hartnell's system (fig. 3) is correctly designed, and with Messrs. Claytons' well-known accuracy of workmanship should be very efficient.

In the writer's opinion, however, the use of the right-and-left handed screw coupling for adjusting the length of the cut-off eccentric rod (except in conjunction with the indicator, for balancing the diagrams from the two ends of the cylinder) is likely to be attended with more harm than good, once the correct length has been found.

The following dimensions are those adopted by Messrs. Clayton for this class of engine :—

Horse-Power.		Cylinder.		Total weight.
Nominal.	Effective.	H.P.	L.P.	cwts.
10	25–30	6¼	10¼	135
12	30–36	6⅞	11¼	159
16	40–48	8	13	190
20	50–60	9	14½	240
25	62–75	10	16¾	310
30	75–90	11	17¾	410

Taking the lower figure in the column of effective horse-power as the normal or working load, and the higher as the maximum or emergency load, these engines have a reserve of power of

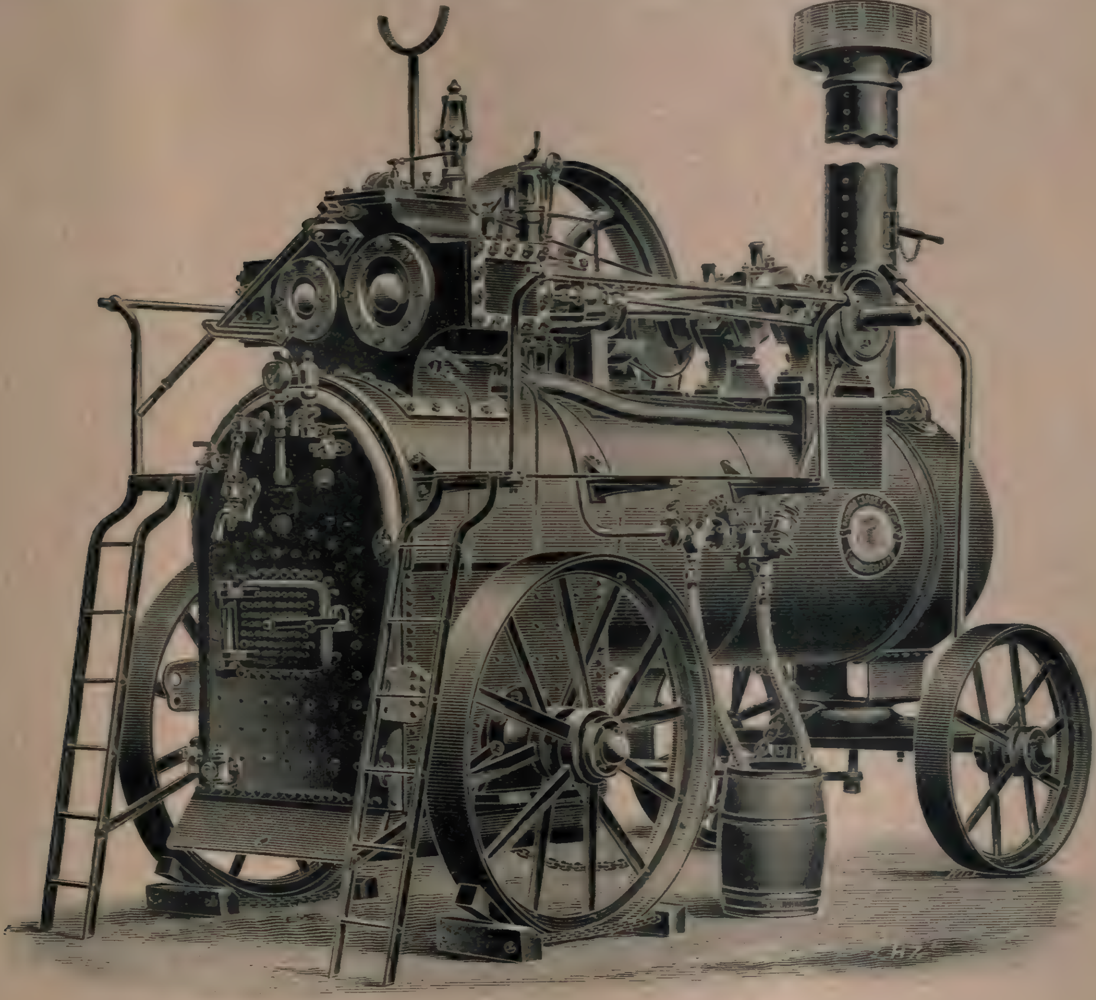


FIG. 4. MESSRS. RICHARD GARRETT AND SONS' (LTD.) COMPOUND PORTABLE ENGINE, WITH GOVERNOR OF THE PICKERING TYPE.

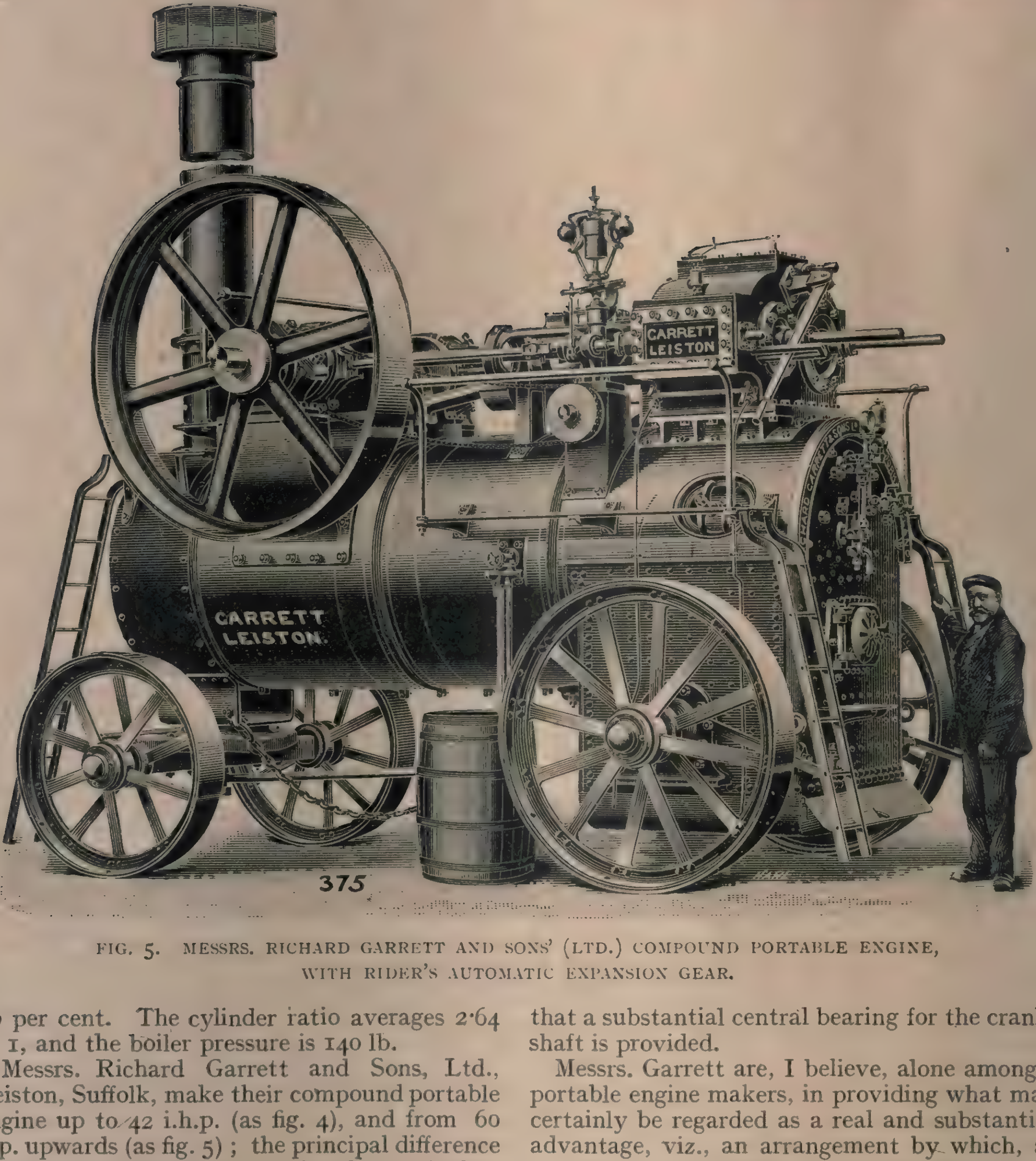


FIG. 5. MESSRS. RICHARD GARRETT AND SONS' (LTD.) COMPOUND PORTABLE ENGINE, WITH RIDER'S AUTOMATIC EXPANSION GEAR.

20 per cent. The cylinder ratio averages 2·64 to 1, and the boiler pressure is 140 lb.

Messrs. Richard Garrett and Sons, Ltd., Leiston, Suffolk, make their compound portable engine up to 42 i.h.p. (as fig. 4), and from 60 h.p. upwards (as fig. 5); the principal difference being in the governor, and in the method of attaching the cylinder to the boiler.

In the smaller series, the cylinder base is curved to fit the boiler, to which it is attached directly, while in the larger sizes the cylinder has a flat base, and is attached to a massive planed base-plate bolted to the boiler. In neither case, do Messrs. Garrett make use of the stay rod system of connecting cylinders and crank-bearings, although they use the admirable steel flanged crank brackets which have been already illustrated.

As in Messrs. Clayton's engine, the steam chests are placed outside, and I am glad to note that a substantial central bearing for the crank-shaft is provided.

Messrs. Garrett are, I believe, alone amongst portable engine makers, in providing what may certainly be regarded as a real and substantial advantage, viz., an arrangement by which, at starting, the two cylinders exhaust independently of each other, high-pressure steam being, for the moment, supplied direct to each. This is certainly an improvement over the ordinary by-pass valve.

It will be noticed that in fig. 4, which illustrates the smaller sizes of their compound engines, Messrs. Garrett adopt the well-known Pickering governor, which has already been illustrated in connection with their single-cylinder locomobile. In the larger sizes, however, automatic expansion gear is provided, and in the writer's opinion, it is almost a *sine quâ non* for this class of engine.

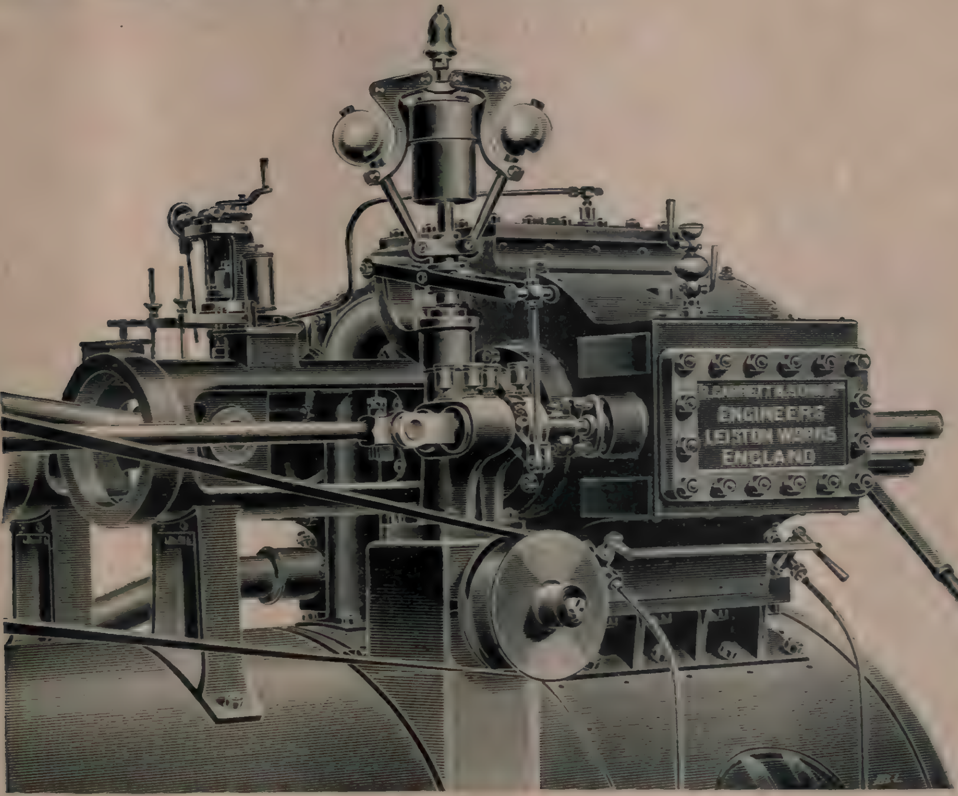


FIG. 6. THE RIDER AUTOMATIC EXPANSION GOVERNOR AND MÖLLERUP OIL PRESS.
(Messrs. Richard Garrett and Sons, Ltd.)

The Rider automatic expansion governor, which is well shown by fig. 6, effects its object of cutting off the influx of steam to the high-pressure cylinder, at any point of the stroke, determinable by the height of the governor—which, again, is proportioned to the speed of the engine—by partially rotating the expansion valve round its axis. The steam ports in the main slide valve are inclined, and the expansion valve, which is circular in cross section, is formed with helical edges to correspond.

When the governor is "up," the virtual length of the expansion valve is greatest, and the point of cut-off is at *o*. As the governor lowers the valve rotates, becoming in effect shorter, thereby allowing the steam to enter for a longer period of the stroke.

The Rider valve gear, though an English invention, is more much extensively used on the Continent than in this country, Messrs. Garrett, I believe, being the only British firm of engine builders who adopt it as their standard design. Incidentally, it may be noted in fig. 6, the Möllerup oil-press, which, *per contra*, is a Danish manufactured article coming largely into use in Great Britain, for forcing lubricating oil into the cylinders by a ratchet-and-screw plunger worked by any reciprocating part of the engine.

Altogether, Messrs. Garrett's engine possesses many features of interest, differing as it does in almost every point of detail from the Lincolnshire type favoured by most of the other manufacturers of this class of engine.

Messrs. Garrett's tabulated particulars are as follows :—

Horse-Power.		Cylinder.			Revs.	Total weight.
Nominal.[*]	Effective.	H.P.	L.P.	Stroke.	per min.	cwt.
8	14–20	6	8½	12	150	110
10	20–30	7	10½	12	150	130
12	25–35	7¾	11½	12	150	150
16	35–50	9	13	14	130	220
20	48–65	9¾	14½	16	130	270
25	60–80	10¾	16	16	120	300
30	72–100	11¾	17½	18	110	375

[*] This column is inserted for purposes of comparison only, Messrs. Garrett having discontinued the use of nominal horse-power altogether.

The margin of power as between the normal and maximum effective horse-power varies from 50 per cent. in the ten horse size, down to 25 per cent. in the 30 h.p. The cylinder ratio is about 2¼ to 1, and the boiler pressure is 140 lb.

(*To be continued.*)

NAVAL NOTES.

MONTHLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

By N. I. D.

GREAT BRITAIN.

THE state of the ships building for the British Navy is in many respects quite satisfactory. There is no unusual delay in the rate of construction, and, indeed, it may be said that the state of affairs at the time of writing is well within the average. From a variety of unofficial reports, the salient points are these. The *New Zealand* is now in the large basin at Portsmouth, and her machinery has been fitted. Work on her is not being rushed, but it is hoped to have her ready for her steam and gun trials early in the spring of next year. The *Hindustan*, at Clydebank, is also progressing favourably. She is in a somewhat more advanced state than the *New Zealand*. A steady supply of material has contributed to the excellent progress made with the *Britannia* at Portsmouth, and in some circles it is stated that she may be ready for launching by December. The plating has reached the upper deck, and the stempost and the stem are both in position, but a good deal of work remains to be done, and it may not be till April next that she will be ready to take the water.

Turning to armoured cruisers, the most important item of news concerns the *Black Prince*. This vessel is to be launched at Blackwall on October 10th, Lady Selborne performing the naming ceremony. The later vessels of this class are all in hand, but at the best possible rate of building, none of them can reasonably be expected to take the water for another six months. The *Cornwall*, of the "County" class, has been passed into the Fleet Reserve at Devonport, and will shortly be commissioned. The alterations to the armament of the *Roxburg* will delay her completion.

Drawings for the new cruiser, for the commencement of which provision is made in the current programme of shipbuilding, have been sent to Pembroke. The publication of some particulars about these vessels has shown that proportionately they are as formidable as the other new vessels designed by Mr. Watts. While they are 10 ft. shorter than the *Drakes* of the British Navy, and are less heavily armoured than the *Duke of Edinburgh* class, they are to have a far more powerful armament than any of their precursors. Their principal armament is to consist of eight 9·2-in. guns, with a secondary battery of 7·5-in. pieces. The nearest approach to these vessels which has yet been designed is the American *Tennessee* class. In coal capacity, the new British vessels have the advantage and, although designed for 23 knots, may, not unreasonably, be expected to attain an even higher speed.

In the third-class cruiser class, the *Sapphire*, building at Palmers' works, is all but completed, and will shortly be delivered, and the *Topaze*, building by Laird Bros., has successfully undergone her contractor's steam trials.

Two more scouts, making a total of four in all, have been launched, the *Forward*, on August 27th, from the yard of the Fairfield Shipbuilding Company, and the *Adventure*, at Elswick. These vessels approximate in size, although they differ slightly in details, owing to the license given to the builders to exercise to some extent their own discretion in building them. There are still four under construction, these being the batch provided for in the Estimates, 1903–04.

The *Kennet*, torpedo-boat destroyer, on two recent trials—one for full speed, and the other for coal consumption—attained speeds of 25·89 and 25·99 knots respectively.

The new fisheries-protection cruiser *Canada*, built by Messrs. Vickers, Sons, and Maxim, Ltd., for the Dominion Government, has been completed, and delivered. Her speed on trial was 17·25 knots, the engines developing 1,800 h.p.

FRANCE.

The most important item of information concerning the French Navy during the past month has been the publication of particulars about the new armoured cruiser, known hitherto as C16, to which the name *Edgard-Quinet* has now been given. Originally, it will be remembered, this vessel was intended to be of the *Ernest Renan* class, but new plans have now been drawn up, which will have the effect of considerably improving this vessel as a fighting unit. Her displacement is to be 14,300 tons, with a length between the perpendiculars of 528 ft., and she is to carry from 9·4-in. guns, as primary armaments, being made up of sixteen 6·5-in. and eight 2·56-in. pieces, with also sixteen small guns. The big guns will be carried in turrets, fore and aft, but twin-mountings for the secondary armaments are to be abolished. There will be a complete belt of steel of about the same thickness as that in the *Gambetta* and *Michelet*, and the casemates will be 4 in. in thickness. Further particulars anent the protection are lacking.

The engines of the *Edgard-Quinet* are to develop the enormous h.p. of 40,000, giving her a speed of 24 knots. Her coal capacity at maximum draught will be 2,400 tons, giving her a radius of action of 12,000 miles at 10 knots, and at full speed 1,700 miles. Comparing this vessel with others of approximate size, we are forced to the conclusion that she will be stronger and in many ways better than the *Drakes*, although it is doubtful if she is equal to the *Black Prince*, and her sisters, and certainly not to the latest vessel of this class, to which reference is made above. The enormous power of the engines seems a doubtful advantage for an extra knot speed, and, before passing a definite verdict on the merits of the design, naval architects will want more detailed particulars.

The *Leon Gambetta* has now resumed her trials, and has developed 22·2 knots, with engines working at 25,000 h.p. She also made 20 knots on an earlier trial with engines only developing 16,050 h.p.

The building of torpedo craft for the French Navy proceeds apace. At Havre, two torpedo-boat destroyers and six torpedo-boats have recently been commenced, the former of 350 tons displacement, 7,200 h.p., and 30 knots speed, the latter of 100 tons displacement, 2,000 h.p., and 26 knots speed. Two torpedo-boat destroyers, M 38 and M 39, building at Rochefort, have received the names *Carquois* and *Trident*. The turbine destroyer 294 has been launched by the Chantiers de la Gironde, and will shortly begin her trials. Torpedo boat No. 290 on trial has attained a speed of 27·4 knots, 281 made 25·85 knots, and 285 27·3 knots.

GERMANY.

The new battleships, of the *Braunschweig* type, slightly improved, to which reference was made last month, are to be known as the "*Commas*" class. They are to displace, as do the *Braunschweigs*, 13,200 tons, but both in armour-plating and armament, there are marked differences. The armour plating amidships is to be 9·4 in. thick, and the citadel plates are increased from 3·93 in. to 7·8 in. in thickness.

The secondary battery, moreover, is placed not in rotary turrets, but in separate armoured casemates. The main battery remains the same as in the *Braunschweig* class, but the smaller pieces are increased in number, there being twenty-two 3·43-in. light machine guns. Further particulars of these vessels are lacking, but it seems evident from the few facts known, that while the *Commas* is a great improvement on the *Braunschweig* and her sisters, she is not equal to the *King Edwards* of the British Navy, and it is doubtful if she is even a match for the French *Republique* class.

The German Naval Budget for 1905 makes provision for the laying down of two battleships ot this class, and one large and three small cruisers. These two battleships will be the last two of the *Commas* class " Q " and " R," " N " " O " and " P " having been already commenced. I omitted to mention last month that " O " is in hand at the Vulcan Yard, Stettin. In the Budget for 1905, there is a third instalment for " N " and a second for " O " and " P " and final provision is made for the *Preussen* and *Hessen*. A second instalment is also provided for the large cruiser " C," which is building in the Weser yards, Bremen, and for the small cruisers " N," *Ersatz, Alexandrine*, and *Ersatz Meteor*. These three small vessels are to be finished by 1906. The *Bremen*, name ship of the class, has been completed and passed into service on the Central American station. On her trails she attained a speed of 23·29 knots, with an i.h.p. of 12,000, her contract figures in each case being 22 and 10,000 respectively. The *Hamburg* on trial also gave excellent results, making 23.15 knots, with 11,582 h.p. at forced draught, and 20·4 knots with 7,241 h.p. at natural draught.

UNITED STATES.

No fewer than four launches of warships have taken place from United States yards during the past month. Of these, the most important is, of course, the shipping from the ways of the *Louisiana* battleship at the works of the Newport News Company, a month in advance of the *Connecticut*, which will have taken the water by the time these lines appear. Descriptions of these vessels have appeared in these notes before, and it is unnecessary therefore to go into particulars again now.

The second launch of importance was that of the protected cruiser *Milwaukee* at San Francisco on September 10th.

The *Dubuque*, gunboat, was launched by the Gas Engine and Power Company, New York, on August 15th, and two days later the *Cumberland*, steel training ship, took the water at the Charleston Navy yard.

Seven new vessels will be ready for commissioning between now and May, 1905: the battleship *Ohio*, the armoured cruisers *West Virginia, Colerado, Maryland*, and *Pennsylvania*, and the protected cruisers *Galveston* and *Charleston*. This will leave to be launched and commissioned twelve battleships, seven armoured cruisers, and three or four small cruisers.

It is stated that the Bureau of Construction is considering tentative plans for a 16,000-ton battleship, whose armament is to consist of four 12-in. and eight 10-in. fifty-calibre guns, with no others larger than 3 in.

MINOR NAVIES.

AUSTRIA-HUNGARY.—The Budget for the Navy for 1905, including ordinary and extraordinary charges, amounts to 51,026,410 kr., while there is a supplementary estimate of 22,000,000 kr. for new construction, guns, coal, etc. The sums include the final instalment for the cruiser *St. George*, a fifth instalment for the battleship *Erzherzog Karl* and the *Erzherzog Frederick* receives a fourth instalment. The battleship " C " receives a second instalment.

SWEDEN.—The armoured cruiser *Fulgia*, the first vessel of this class to be built for the Swedish navy is expected to be completed in about a year's time. In length she is 377·3 ft. and displaces 4,100 tons. With engines developing 12,000 h.p. she is to attain a speed of 21·5 knots. Her armour protection consists of a belt 3·94 in. in thickness, with turrets protected by 5 in. armour. These turrets, four in number, will each contain two 5·9-in. guns, and as secondary armament fourteen 2·24 guns will be carried.

GREECE.—The committee appointed to consider in what way the Greek navy can best be brought up to modern requirements, has reported that at least three new armoured cruisers and eighteen destroyers should be put in hand at once, and it is understood that this recommendation will be acted on. The armoured cruisers are to displace from 6,000 to 7,000 tons, and have a speed of 18 knots, while the destroyers are to be built for 30 knots. Tenders have been nvited from Germany, Italy, France, and England.

NOTES.

Mr. A. Mount-Haes, M.I.Mech.E., who has taken over the London offices of the Humbolt Engineering Company, of Kalk, has removed them from 37, Walbrook to 11, Ironmonger Lane, E.C.

The British business of the International Time Recording Company has been taken over by an English firm, under the title of " Recorder's Limited." This will involve no change in the offices of the company, at 171, Queen Victoria Street.

Messrs. Sam Deards, Ltd., of Victoria Works, Harlow, and 34, Old Broad-street, E.C., have in hand the patent glazing of the large new factory at H.M. Dockyard, Portsmouth.

We are informed that Mr. F. C. Gibbons, M.I.E.E., has rejoined the firm of Messrs. Browett, Lindley, and Co., Ltd., as sole managing-director. Mr. Gibbons' connection with the firm as a co-director is of long-standing, but he left a year ago to join Messrs. Howden and Company.

Mr. Park, formerly of Messrs. The Power Pulley Company, Manchester, has joined the firm of Messrs. David Bridge and Co., engineers, Castleton, Manchester. Since the completion of their new works at Castleton, Messrs. David Bridge and Co., have made rapid strides and have taken up many specialities, independently of their improved patent friction clutches, gearing, and hauling installations. The works are fitted up with the latest labour saving tools.

LOCOMOTIVE ENGINEERING NOTES.

BY CHARLES ROUS-MARTEN.

The G. W. Ten Wheelers.

Excellent work is being done by the three six-coupled express engines on the Great Western Railway, Nos. 98, 100, and 171. All are now on regular duty of varied character, and they appear always to perform it as well as could be desired. The three are alike now save that No. 171 ("Albion"), has 225 lb. steam pressure—for purposes of comparison with "La France"—while Nos. 98 and 100 have only 200 lb. The difference of course necessitates greater strength and consequently greater weight in the boiler, etc., in the case of the engine with the higher pressure and so for the present No. 171 is kept at work between London and Bristol. The other two run all the way to Plymouth, and indeed are frequently employed on the up and down non-stopping expresses which leave Paddington and Plymouth at 10.10 a.m., and 12.35 p.m. respectively. Twice lately I have seen No. 98 on those trains, and keeping time with perfect ease. Manifestly as the loads of those are so light—seven corridor bogies, or about 175 tons, being the maximum—there could be no possible doubt on the score of haulage power, but some engineers doubted whether a six-coupled engine would do satisfactory work when required to maintain such a high rate of velocity for so long a distance and time—4 h. 25 min. continuously. However the result so far has been to resolve all such doubts in the most favourable way, and the view has been entirely borne out which I expressed long ago in these columns, that the six-coupled type of express engine—which by the way was in use in New Zealand nearly twenty years ago, and which had arrived in the Mother Country at last—had come to stay.

"William Dean" and "her" Work.

No. 100, "William Dean," the Great Western pioneer of this class has been completely rebuilt by Mr. Churchward, since she first came out and now is exactly the same as her successor No. 98, differing from No. 171 only, as I have said, in having 200 lb. steam pressure instead of 225 lb. I made a very interesting trial run with her—No. 100—a few days ago, when she hauled the 12.7 midday non-stopping express from Exeter to Paddington. The load consisted of one dining-car, ten corridor eight-wheelers, and one six wheeler, the total weight, including passengers, luggage, staff, and stores being approximately 320 tons behind the tender. The booked time for the distance of 193¾ miles was 3 h. 30 min., representing an average start-to-stop speed of 55·3 miles an hour. A permanent-way slack had to be observed near Bridgwater, there were the usual service-slacks at Bristol and Bath—the latter, however, being now only to 25 miles an hour—and signal checks were encountered at St. Ann's, Foxhall, and Westbourne Park. Nevertheless the run of 193¾ miles from Exeter to London was accomplished in 3 h. 22 min. 34 sec. inclusive, without any allowance for delays. If these—excluding the regular service slacks were taken into account the net time would be just 3¼ hours. A similarly good performance was given me by No. 171, from Paddington to Bristol on the 10.50 down Cornish Express.

New and Old South-Westers.

Five of Mr. D. Drummond's newest express locomotives are now at work on the London and South-Western Railway. They all have the larger boilers and cylinders which Mr. Drummond gave to his 6 ft. "399" class, but retain the 6 ft. 6 in. coupled wheels of the "702" or standard express class. Nos. 415–419 are already out, replacing as many old engines built by the late Mr. W. Adams. The announcement of the death Mr. Adams I observed recently with sincere regret. Mr. Adams, who attained a good old age and who had long retired from active work, was in his day one of the foremost of British locomotive engineers. He left his mark strongly on the North London, Great Eastern and London and South-Western Railways, successively, and his most noteworthy invention, the vortex blast-pipe, has proved a very valuable acquisition to the fittings of modern locomotives. A large number of Mr. Adams' engines may still be seen at work on the South-Western line. His earliest express type on that line was represented by a batch of twelve, Nos. 135–146, built by Messrs. Beyer, Peacock and Co., with 6 ft. 6 in. coupled driving-wheels and inside cylinders 18 by 24. These were very good machines in their time, but I believe that they have all, or nearly all, disappeared. Then came Mr. Adams' first lot of 7 ft. coupled, Nos. 445–456, immediately followed by Nos. 460–478, 147 and 526, with 6 ft. 6 in. wheels, both classes having inside cylinders 18 by 24. Next came the inside cylinder mixed-traffic class with 6-ft. wheels coupled in front, and cylinders 18 by 26, and finally the sixty express engines with cylinders 19 by 26—the outside position being reverted to. Thirty of these, Nos. 577–596 and 677–686 were given 7-ft. coupled wheels and thirty—Nos. 557–576, 657–666, 6-ft. 6-in. wheels. Excellent service has been done by all of these classes and I believe that all the engines are still doing regular duty.

"Still they (the Atlantics) come."

My long-ago-expressed conviction that the "Atlantic" or 4–4–2 express type, like the six-coupled or 4–6–0 type, had "come to stay" in Britain, is being abundantly verified. Mr. Ivatt has just added twenty of these fine engines to the Great Northern locomotive stock. This brings up their total number on that line to forty-three, viz., Nos. 949, 950, 982–990, 250–260, 271–291. Of these Nos. 251 and 272–291 have the large 5 ft. 6 in. boilers with 2,500 square feet of heating surface, and No. 271 is the one which was built with four cylinders 15 by 20. All the rest have outside cylinders 18¾ by 24. On the North Eastern, Mr. Worsdell too, is adding to the number of his large "Atlantics" and five more of Mr. Robinson's design—Nos. 263–267—have lately been delivered to the Great Central. All these engines, Great Northern, North-Eastern and Great Central alike, are exceedingly fine, and should tend to facilitate more economical working by reducing the practice of piloting and of train-duplication.

L. and N. W. and Midland Doings.

Mr. Whale has brought out two more of his excellent "Precursor" class, with 6-ft. 9-in. coupled wheels, inside cylinders 19 by 26, and 2,009 square feet of heating surface. One of these has received the name "Dreadnought," which belonged to No. 503, the pioneer of Mr. Webb's 6-ft. wheel three-cylinder compounds, while it takes its number, 659, from another of that class named "Rowland Hill," both of which are doomed to the scrap-heap. The other is named "Albatross," after one of the converted small "Precursors" but its number 510 belonged to "Leviathan," another 6-ft. compound, also doomed. The antepenultimate "Precursor," which takes the name "Titan" from the second-built of the 6-ft. wheel "Dreadnought" compounds, is numbered "7" which means that the previous bearer of that number, the 7-ft. 6-in. single-wheeler "Scorpion" has also been condemned. I hear that no fewer than fourteen of the 6-ft. compounds have now been sentenced to destruction, viz., "City of Carlisle," "City of Liverpool," "City of Chester," "Dreadnought," "Titan," "Ajax," "Leviathan," "Vesuvius," "Ambassador," "Rowland Hill," "City of Edinburgh," "Euphrates," "Argus," and "Vandal." This leaves twenty-six still running. On the Midland Railway, Mr. Deeley is building more of the Belpaire non-compounds. To the fifty already at work, whose numbers range up to 839, he is now adding a fresh batch beginning with No. 840. He is also multiplying the large-boilered goods class and is rebuilding with bigger boilers a number of Mr. Johnson's old 6-ft. 6-in. coupled express and his six-coupled goods engines.

Compliment to British Locomotive Engineering.

Another high compliment has, I hear, been paid to Mr. McIntosh, locomotive superintendent of the Caledonian Railway. It will be remembered how, seven years ago, the authorities of the Belgian State Railway adopted his "Dunalastair" type as their standard. They have since had constructed a large number of these excellent engines. But when Mr. McIntosh went in for his huge six-coupled design, of which Nos. 49 and 50 are the exemplars, the Belgians felt sure there must be something in the idea and speedily adopted it. I understand that they have ordered no fewer than twenty of this type, of which one is already at work. This must be deemed, a very great and exceptional—if not unprecedented—compliment to a British engineer; but those, who like myself have carefully tested and studied the actual work performed by Nos. 49 and 50 on the Caledonian Railway, will not be disposed to think it at all misplaced. I may add that both of the Belgian State Railways goods engines, exhibited at Paris in 1900 were built from Mr. McIntosh's standard Caledonian designs. British engineers can teach the world something even yet.

A Feat by "La France."

If one cannot but regard the presence of the French engine on the Great Western railway, as an instance of the influence of foreign locomotive engineering upon British practice—for the engine herself, No. 102 "La France," must be deemed of French origin, her designer being M. du Bousquet, and her builders the Société Alsacienne of Belfort—yet her leading principle and special excellence is due to the genuis of one who is an Englishman by birth even if his name seems foreign and though he has long belonged to France, if not to Germany as well—M. Alfred G. de Glehn—whose system of compounding has proved the most efficient of any yet tried in a locomotive. "La France" has recently accomplished a brilliant feat. Starting from Exeter with a load of twelve of the largest corridor-bogies, one being a diner, the whole weight behind her tender including passengers, staff, luggage, and stores being nearly 330 tons, "La France" ran the 75½ miles to Temple Meads station, Bristol, in 72½ minutes, start to stop, thus averaging 62·5 miles an hour, although she had to face a 20 mile climb at the start, the last 27 miles of this stretch being at 1 in 115. This sort of work speaks for itself, and proclaims its own merit.

The du Bousquet-de Glehn Compounds.

But the performance of "La France" did not end here. She went on from Bristol to London, 118½ miles, with the same heavy load, in exactly 118 minutes. Her time from Bath to Paddington, 107 miles, was 104 minutes, from Swindon, 77¼ miles, 72 minutes, from Reading, 36 miles, 33 minutes. This is very smart going, but I do not for one moment say that one of the British-built Great Western engines could not equal it. My impression is that one of the "Cities" almost certainly could. But then I do not consider that even this fine run represents the *ne plus ultra* of the de Glehn compound, judging from what I have seen her sister-engines do abroad. It is rather interesting by the way, to note that the latest and largest development of these du Bousquet-de Glehn engines—that which was constructed for the Paris-Orleans Railway of France, and which is far larger than the one supplied to our Great Western line, is represented at the St. Louis Exhibition by a sister locomotive expressly built for the Pennsylvania Railway of America. This largest type, of which eight are now at work on the Paris-Orleans Railway and are numbered 3,001–3008, has the same sized driving-wheels as "La France," viz., 6 ft. 8 in. in diameter, and the same steam pressure, 228 lb. per square inch, and the same piston-stroke, 25¼ in. but has a bigger boiler, with 2,577 square feet of heating surface, of which the Belpaire firebox contributes no less than 174 square feet, and also larger cylinders, the two high-pressure cylinders being 14¼ in. and the two low-pressure 23½ in. in diameter, while the engine alone weighs no less than 73 tons in working order, or some eight tons more than "La France."

THE MIDLAND IRON TRADE.

A SERIES of district meetings which have been held throughout the area of the Midland iron trade culminated recently in a general assembly of delegates at Wednesbury to deliver the decision of the organised operatives on a proposal to terminate the existing sliding scale by which wages are regulated. The districts concerned comprise South Staffordshire; North Staffordshire, Shropshire, East Worcestershire, Derbyshire, South Yorkshire, and Lancashire,

The meeting is reported to have been fully representative. Mr. W. Aucott, president and operatives' secretary to the wages board, occupied the chair. The proceedings were conducted in private, but it was afterwards announced that the vote was overwhelmingly in favour of terminating the sliding scale, only three lodges dissenting. It was resolved "That three months' notice be given to terminate the present sliding scale agreement, and that the Board's accountant be instructed to discontinue taking out the returns of selling prices from the books of the firms now comprised within the audit after the two months ending October 31st, 1904." Mr. J. Cox, general secretary, alleged that the devices employed by the ironmasters had brought the sliding scale into disrepute. The workmen wanted a really solid representative basis for the regulation of wages.

ELECTRICAL AFFAIRS.

BY

E. KILBURN SCOTT, M.I.E.E., A.M.INST.C.E.

Compound Winding of Motors.

Motors are not often compound wound because of the extra complication involved in the starting switches and the field coils. Under certain conditions there is no doubt that a few turns of series winding is an advantage. As, for instance, where a motor has to drive a planing machine or shearing machine. In that case the motor will take a large momentary overload with less chance of sparking, because the series turns on a motor when they help the shunt improve the sparking limit in much the same way as they do the sparking limit of a traction dynamo.

There is no great advantage in adding series turns for the simple purpose of improving the speed regulation, because a properly made shunt motor is so very nearly perfect in this respect. In case series turns are added for such a purpose, they must be in *opposition* to the shunt winding, so that as the load comes on, the field is weakened, and the speed goes up. Naturally, by being in opposition, the motor is not so well able to take overloads, and there may be also some little difficulty in starting up the motor.

One form of motor driving for which compound winding would be quite unsuitable, is when a motor is used for driving a single crank pump or a short strike planer. The very rapid fluctuation of torque required is apt to cause a fluctuation of current round the magnet coils, and so cause heating.

The Grisson Reducing Gear.

This gear consists of a pair of cams so arranged as to form a two-toothed pinion, the cams meshing into a wheel consisting of two plates joined together by pins. The objection with ordinary high reduction spur gearing is that the pinion must have not less than about 12 or 15 teeth, otherwise they soon become worn. It will easily be seen that if a gear can be made in which the pinion shall have only *two* teeth, that a very much larger reduction can be obtained in a given space. With the Grisson gear a reduction of as much as 30 to 1 can be obtained, whereas with an ordinary spur gear 6 to 1 is about the usual maximum. The writer saw the gear in use in Norway some years ago for electric lift work, and except that it was a little noisy, it appeared to work exceedingly well. Amongst the firms who have adopted the gear in this country are Waterlow and Sons, who have twelve gears at work for 4 to 5 h.p. motors running at 750 revolutions for driving their copper-plate printing machines. These machines have to be constantly started and stopped, and considerable starting torque is required, and the gear is said to meet the conditions very well.

Printing of Drawings by Electric Arc.

The printing of drawings by the electric arc ranks as one of the most important improvements of recent years in what may be called the clerical side of engineering. The use of the arc for printing blue prints dates from about 1890, the method in those days being to range two or three ordinary flat frames round an arc lamp. As even exposure of the prints could only be obtained when the lamp or lamps were stationed at a considerable distance from the printing frame a long and expensive exposure was necessary. If the lamps were brought near, the exposure was uneven, and the glass in the flat frames became unequally heated, and often broke.

Such an apparatus would produce two blue prints double elephant size in 12 to 15 minutes, the cost per print taking electric current at 6d. per unit, and at 100 volts, was about 4½d. per copy for blue prints, and 1s. 3d. per copy for black line prints.

The Modern Copying Machine.

The Hall Arc printing machine was the first real improvement. It consisted of an open-ended cylinder of glass, through which a single arc lamp was lowered by easy stages, and around the outside of which the photo paper and tracings to be copied were wrapped. A single arc lamp under these conditions could turn out at least twice the work of two similar arc lamps with flat frames, giving an economy of 75 per cent., but, unfortunately, whole cylinders could not be made with sufficient accuracy, and the prints generally showed places where the line was weakened by bad contact.

Subsequently cylinders constructed of two bent glass plates, jointed on wooden battens were introduced. These are easily manufactured with such accuracy that perfect contact is obtained. Moreover, the cylinders never break by the heat even of a 30 ampère open type arc lamp, the shape and construction adopted, viz., vertical joint on soft wooden battens and free ends, admitting of easy expansion. After a time the ordinary open arc was displaced by an *enclosed* arc lamp, specially constructed to give a long arc producing powerful ultra violet rays. An enclosed arc lamp of 10 ampères is able to do twice the work of a 30 ampère open type lamp; and with the actinic light the heating is greatly reduced, and thus the cylinders can be used continuously. The lamps work on a 200 volt circuit taking 160 volts at the terminals, and have an arc nearly 2 in. long. A sliding resistance is required in addition to the fixed circuit resistance, because it is impossible to start a lamp burning steadily on a

200 volt circuit with more than 130 to 140 volts at the terminals. By gradually reducing the resistance, the terminal voltage increases, the arc lengthens, the light becoming more violet, and working with greater efficiency.

Where a 450 volt circuit is available, then the lamp works with 280 volts at the terminals, and the arc is about 4 in. long and very highly actinic.

Electrical Power for Gold Dredgers.

Amongst the many interesting uses of electrical power in mining operations abroad, that of driving gold dredgers takes a prominent place. The dredgers are located on shallow rivers, and have to be continually moved along by winches, so that the bucket dredge may continually attack fresh ground. This bucket dredge requires a good deal of power in order to work it, as also do the winches and the screens and other mining machinery. The dredgers have been very successful in California and New Zealand, and it has been found that there is great saving by driving the machinery electrically. It will be seen that it is much easier to carry a wire from the bank to the dredger than to have to carry coal, wood, or other fuel with which to drive steam engines. As a rule the power is transmitted from a waterfall on the same river.

Shunt Resistances for Motors.

Shunt resistances for motors should on no account be fitted with an off contact, as, if so, the shunt current may be unwittingly cut off whilst the armature is in circuit, and the result would be either over-heating or the motor running away. In any case when arranging shunt resistance care must be taken to limit it to the capacity of the design of the machine. Otherwise the weakening of the field and consequent increase of speed may result in so diminishing the field magnetic flux that the action of the armature current becomes overpowering and the machine commences to spark.

Time of Starting Motors.

In fixing the proportions of a starting switch and resistance it is generally assumed that the motor will run up to full speed in half a minute or so. There are cases, however, such as when a motor drives a hydro-extractor, a heavy grindstone, or circular saw, when it may take several minutes for the motor to get into its pace. If an ordinary starter is used in such a case, the resistance may be all cut out before the motor has got fairly started and the rush of current may burn out some coils. It is most important, therefore, for the supplier of the starting switch to inquire as to the duty which the motor is to perform, otherwise electric driving may be brought into disrepute, which is not desired.

Number of Wires on Small Motors.

Amongst those who are not actually conversant with dynamo machine design, it may seem a very desirable thing to employ motors working at high voltage and slow speed so as to reduce the line losses, and also belt and gearing losses as much as possible. A consideration of the matter however, will show that in striving after these things the motor may be made expensive and have a very delicate constitution. For example, a 2-h.p. 230-volt motor to run at 1,500 revolutions a minute will have a core say 7 in. diameter by 5 in. long with 40 slots each containing 26 No. 17 S.W.G. wires, or 1,040 in all. Now, if it is desired to run this same machine at 300 revolutions and with a voltage of 500, the power would be ½ h.p., and the number of wires would need to be increased over ten times, at the same time the number of turns on the field goes up from 12,500 of S.W.G. to over 30,000 of a smaller sized wire. In fact, on account of the insulation on so many more wires it is difficult to crowd them on to the same carcase.

Short-Circuited Coils on Motors.

One of the most common faults in motors is when an armature coil is short-circuited at two points. In case of a dead short between two separate coils the short is so serious that the motor stops immediately and a good deal of the winding will probably be burnt out. A short on a single armature coil is however, not so serious a matter, and is, sometimes, a little difficult to locate. One curious feature of this kind of fault is that the motor shows a tendency to run backwards at a reduced speed. By letting it run a little the current heats up the short-circuited coil more than the others, and this will be perceptible to the touch.

Connecting Series Winding for Motors.

In connecting up the series turns of a compound motor, such as is used for cranes, hoists, etc., it is important to get the current travelling in the right direction, otherwise the motor may run away. Series turns are usually added to increase the torque at full load, and to do this the current must flow *in the same* direction as in the shunt. This results in an increase of magnetic flux at full load and the speed drops perhaps 20 or 30 per cent. If the series turns are wrongly connected they will weaken the field instead of strengthening it, and this will give such a greatly increased speed as to break the gearing or apparatus to which the motor is coupled.

The Electric Lighting of Booths.

The writer recently visited Dartford open-air market, and noticed that the booths which line one side of the High-street were all electrically lighted by Nernst lamps. This method of lighting is in every way a very great advantage over the old system of flaring petroleum lamps, as it not only sets off the goods in better shape, and is much safer, but there is also an absence of the extremely objectionable smell which accompanied the old-fashioned flare lamp. The Dartford Electric Light Committee are to be congratulated in arranging for this service to the owners of booths. It is a move which might well be adopted in all small towns which have an electrical plant.

Electrical Power in India.

Inexhaustible power can be obtained from the head-waters of almost all great rivers in India. The Government of India has for some time been experimenting to get the power required for Jubbulpur military works from the Falls of the Narbuda. All who have had the experience of travelling round the hill stations of the Himalayas or other hill ranges know the existence of a number of waterfalls, whose power may be easily utilised to supply electricity at a moderate cost. For example, the Victoria Falls at Darjiling, many falls on the road to Cashmere from Murree, and in Chota-Nagpur. The use of waterfalls to supply power for the generation of electricity is best appreciated in places where coal is scarce and expensive.

AUTOMOBILE NOTES.

By J. W.

The Small Car Trials.

The judges in the trials of small cars at Hereford (selling price not exceeding £200), were able to report that on the whole the general design and construction of the cars showed much improvement on that of cars of the same capacity in previous years; and what is also very much to the point, the prices were all lower. The judges report makes very interesting reading, but the exigencies of space are inexorable, so I must refrian from going into the details of awards. Their remarks on construction are, however, of so much importance that they are worthy of more than passing attention and study by the manufacturers of motor-cars.

Points in Construction.

Of the cars which failed to complete the runs a few, nevertheless, of promising novelty, and some of already proved merit failed in consequence of defects not likely to be recurrent. A large number of cars appeared to be made up of almost identical parts, individually well designed, but roughly and sometimes flimsily assembled. This was particularly noticeable with regard to parts of tubular frames, back axles, gear box, and engine connections, Several of the tubular frames were made with weak lugs carrying the underframe, and five of these lugs broke during the trials.

The majority of live back axles differed little in design, except that some had trussing stays to the bevel gear-box, whilst others left the somewhat heavy weight in the middle of the axle insufficiently supported. The bevel gear-box of some axles is conveniently arranged to permit withdrawal of the bevel pinion without dismantling the axle. The Wolseley, Siddeley, and Prosper-Lambert cars carry the back wheels on extensions of the tubular part of the axle, thus relieving the differential axle of all weight and all stress other than that of torsion—a construction to be commended. In more than one instance it was found that the axles were neither parallel not at right angles to the frame, nor did the front wheels track with the hind wheels. Although no appreciable difference in the wear of the tyres was noticed at the end of the 620 miles of running, the result of improper alignment of axles cannot but have a detrimental effect on the life of some or all of the tyres.

In the construction and arrangement of brakes great improvement was shown. The side brakes on a few cars are effectively compensated, but in others, where wire rope with sharp bends is used, the intended compensation is not effective. In several cases the absence of a flange on the inside of the brake drum permits the band to wander from its place. The foot brakes were generally effective, but several, when applied, showed a tendency to displace and strain the gear-box shaft, causing unnecessary wear of the bearings. Adjustments of some kind, though not always accessible, were provided on all cars.

Many cars had steering gear of the rack-and-pinion type, with the rack not protected in any way from the ingress of dust and mud. All these showed signs of considerable wear, and some were nearly worn out. The steering gear was in several cases poorly attached to the frame by a single bracket flange. With a steering rack some distance below, not stayed in any effective way to take the thrust, a twisting strain is thrown on the bracket, and causes looseness. Pins in the links of the steering gear frequently had small wearing surfaces, which give rise to backlash and rattling, but on the whole there was a general improvement in the design and construction of steering gears. As might be expected, the number of tyre troubles was exceedingly small.

Twenty-two of the engines which completed the trials were vertical and four horizontal. Many of the vertical engines had their commutators placed in inaccessible positions close to the front or side of the frame.

Causes of Stoppage.

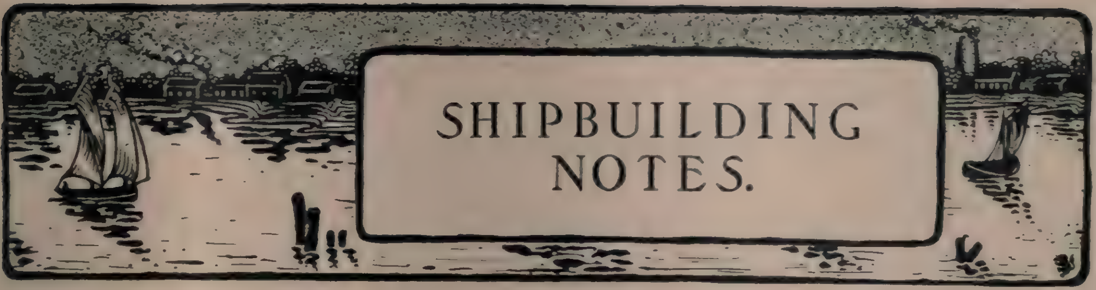
One of the most frequent causes of stoppage was defective junctions in pipework. Rubber connections on water pipes are often too short, and the edges of the pipe ends, aided by vibration, cut through the rubber. Petrol and oil pipes frequently broke off at the terminal collars or unions, owing to neglect to anneal after brazing, and to the vibration of long unsupported lengths of pipe. Slack-fitting coarse-threaded unions, which came unscrewed, were numerous. Water pipes attached to tanks without a flange, riveted as well as soldered, in several cases came adrift. The use of brass flanges on exhaust pipe connections caused trouble, and is to be deprecated. The petrol tanks on some cars are inadequate for ordinary requirements, and a few are placed too low to feed the carburetter on steep hills.

Except for broken pipes, no troubles arose through insufficient lubrication. A few cars are fitted with ring lubricated bearings, a feature which might with advantage be more generally adopted. The number of stoppages on the road caused by defects in inlet valves shows the need of attention to proper design of the cottars and the fittings at the end of the stem. There was marked superiority in the cleanliness of those cars provided with good aprons or undercasings. One badly-fitted apron, however, caused trouble, and several aprons, leaving large open spaces, were ineffective.

The electric wiring on most of the cars had received more attention than was usual a year ago, but still left much to be desired. The two cylinder Humber and the De Dions in particular, and also the Swifts, the Mobiles, the Wolseleys, and the Siddeley, have taken special pains to avoid loose wires, with their consequent liability to breakage, more particularly in the case of the heavy high-tension leads. Terminals on British-designed cars were notably better considered than those on the usual foreign type.

The consumption of petrol varied considerably (from 13 gallons, 1 pint, to 39 gallons, 7 pints), for the 620 miles, the best performance (by a 7-h.p. Clyde), being remarkable and the average highly creditable. The performance of the cars generally was remarkably good, but the judges were of opinion that a greater distance than 600 miles is necessary to bring out by automatic records the qualities of the cars and their minor but important details.

They also called attention to the fact that although the non-stop performances provide an automatic indication of some of the qualities of the cars and drivers combined, the important matters upon which the ultimate durability, performance and choice depend are chiefly shown by the examination and consideration of details which take place after the non-stop runs have been completed.



SHIPBUILDING NOTES.

Shipbuilding Prospects.

In some quarters we hear of rather better conditions in shipbuilding circles, as the last term of the commercial year begins. But what improvement there is is far from being general. On the Clyde, for instance, whilst the builders at Greenock and Port-Glasgow seem well supplied with work for the winter, those on the upper reaches of the river are very poorly off, and in two or three cases practically all the hands were paid off in August, for want of new work. It has been pointed out that while the launches from the Scotch yards in August amounted to 32,000 tons, the new contracts booked by Scotch builders during the same month were probably not of less tonnage, and were certainly as much as 30,000 tons. The argument from this would seem to be that the position there is being well maintained. But this is not so, for the new contracts are confined to a very small proportion of the army of builders. These August contracts included three new turbine boats to be built by Messrs. William Denny and Bros., of Dumbarton—one a large cargo and passenger boat for the Union Steamship Company of New Zealand, and two passenger boats of about 1,600 tons each for the Cross-Channel service of the South-Eastern and Chatham Railways. Among the other August contracts were two or three cargo boats, but the bulk of the tonnage was in river steamers, fishing steamers, ice-breakers and barges. In short, the list contains no evidence of any real revival of demand for merchant shipping.

Freight Prospects.

Yet there is some improvement in freights, especially in the East, where, however, the improvement seems largely due to the withdrawal of the boats of the regular lines in the China and Japan trades. As these boats have been taken off rather than run the risk of overhaul by Russian cruisers, a demand has been created for "tramps" which has rather sent up freights. Moreover, the risks and expenses of the trade at present require a rate of remuneration to induce owners to send their boats out. Therefore, such improvement in freights as has occurred in this connection is no indication of better times. There are, however, indications of a prospective enlarged demand for ocean tonnage through the shortage of the European grain harvests, the abundance of the Indian and Argentine crops, and the prospective good harvest in Australia—apart from the probable wants of Russia and Japan when the war is over. The wastage of shipping during the war has been great, and it will have to be replaced. There is, of course, an immense surplus of merchant shipping in the world at present, but it is not being added to at the moment by America and only to a small extent by Germany, whilst the natural wastage is always going on as well as the special wastage due to the war. We should not be surprised, therefore, if 1905 witnesses considerable activity in shipbuilding.

Shipbuilding Costs.

Opinions, of course, differ as to whether or not costs have touched bottom in this country. We are inclined to think they have not, because the price of shipbuilding labour is extremely dear compared with other labour, and has been very little reduced since the time of depression set in. Labour is the chief item of cost in the construction of the hull of a ship, and the price paid for the mere bone and muscle of the riveter is out of all proportion to its economic value. An adjustment of this item should be helped by the more extensive adoption of hydraulic and pneumatic riveting machines, etc. Then, steel ship plates will be cheaper if the Americans make their promised raid on our markets. They have already sold several thousand tons on the Tyne and Clyde, and it is said that they are preparing to unload large quantities during the winter. Our own steel makers contend that prices are already low enough, and their object is by combination to keep up rates rather than allow them to fall to the unremunerative figure. which prevailed during the last period of depressions But no amount of combination will be able to keep up prices if America deluges us with low offers. Moreover, German ship plates are in the market. This is why we are inclined to think that shipbuilding costs have not yet touched bottom. And builders are certainly willing to accept specifications just now at very low figures.

Shipbuilding Labour.

As against the lowering of costs there is the possibility of labour disputes in the industry. With regard to the engineers, the elements for a rupture are always present. At a Central Conference of the Engineering Employers' Federation and the A.S.E., proposals from the districts for reductions, and applications from the men for advances, were considered. No settlement was effected, but the whole subject was adjourned for a couple of months, in order that each side might have an opportunity of examining into the allegations of the other with regard to the state of trade in the several districts. But, meanwhile, the employers on the North-East Coast have notified their intention to reduce wages next month, and if they do so, a strike is by no means improbable. If a strike begins there, it will probably extend to all the shipbuilding districts. The problem will then be what will be the course of action of the Federation of Engineering Employers? The actual trouble will be only in the marine engine shops, but the Federation includes practically all the engineering firms of all descriptions all over the country. We do not wish to anticipate evil but we fear there are troublous times ahead in the engineering trade, of which the general public has at present no inkling. There may also be trouble in the Scotch ship-yards, inasmuch as the General Federation of Shipbuilding Trade Unions has taken up the threshed-out question of weekly pays on the Clyde. The Federated Shipbuilding Employers on the Clyde, in response to the requests of the men three years ago adopted the system of weekly payments for one year. They came to an agreement with the men that if there was less broken time with the weekly than with the fortnightly pay the weekly pay would be made permanent, but that if there was no reduction in the broken time the old system would be returned to. The men agreed to this, but they made no effort to secure a continuance. On the contrary, they took as many idle days in the week as they had formerly done in the fortnight, and at the end of the year the employers declared the experiment a failure, and returned to the fortnightly pays—which it is understood the wives and families of the shipyard workers much prefer. But the Federation of Trade Unions is now taking up the matter as a grievance, and they will rush it to the front when they think the time opportune.

New Turbine Allan Liner.

An important event in shipbuilding has been the launch by Messrs. Workman, Clark and Co., of the *Victorian*,* the first of two turbine-driven vessels ordered by the Allan line, for their Canadian mail and passenger service. She is a finely-modelled steamer with ample accommodation for over 1,300 passengers. In case of war she will be available as a transport, and when engaged in such service she will have a capacity for carrying 3,000 troops. The principal dimensions of the ship are, length 540 ft., breadth 60 ft., depth 42 ft. 6 in., and she has a displacement of 13,000 tons. She is divided by bulk-heads into 11 compartments, which together with the sub-divisions of the double bottom allow the vessel to have 20 distinct water-tight spaces. The *Victorian* is constructed to the highest class of the British Corporation Registry of Shipping, and the strength of the hull has been specially augmented for the requirements of the Classification Society to meet the heavy weather of the North Atlantic. There are eight decks, of which six are entirely for the use of passengers. The funnel has a diameter of 20 ft. The boiler capacity requires some 48 furnaces. Accommodation for first and second-class passengers is of the highest order. Marconi's wireless telegraphic system is installed on board, and by its aid it is intended to publish a daily newspaper in connection with which a complete printing outfit and press are erected. There are insulation chambers for the carriage of fruit and dairy produce from Canada, in conjunction with which there is a large refrigerating plant on the cold air system. There is space available for 8,000 tons of cargo, for the rapid handling and discharge of which special facilities are provided. Messrs. Workman, Clark and Co. have adopted the Parson's patent turbine as that of which shipbuilders have the most experience. There are five engines, three for the purpose of driving the steamer ahead and two to take her astern.

Defective Shipping.

A Parliamentary paper gives details of the cases in which during the period from July 1st, 1903, to June 30th, 1904, Board of Trade officers have detained British ships as unsafe by reason of their defective condition, or because of overloading or improper loading. Similar particulars are given in relation to foreign vessels, and summaries show respectively the total number of ships ordered to be detained as unsafe in the period mentioned and since October 1st, 1876. From the tables, it appears that between July 1st, 1903, and June 30th, 1904, three steamships and one sailing vessel were found to be defective in hull, equipments, or machinery, while 21 steamships and four sailing vessels were declared to be unsafe owing to overloading, or improper loading, 15 of the latter total being foreign. Since October 1st, 1876, the total number of ships ordered to be detained by reason of defects in hull, equipments, or machinery, was 946, of which 232 were classed. Of the full number, 153 were iron steamships, 25 wooden steamships, 14 iron sailing ships and 754 wooden sailing ships. Two iron steamships, and eight wooden sailing ships, were found to be safe, 928 (150 iron steamships, 28 wooden steamships, 14 iron sailing ships, and 739 wooden sailing ships) were declared after examination to be unsafe. One iron steamship and seven wooden sailing ships were improperly detained. The total number of vessels detained on the ground of overloading, or improper loading, in the same period was 1,085; and 1,077 were found to be unsafe—935 iron steamships, 6 wooden steamships, 25 iron sailing ships, and 111 wooden sailing ships. Seven iron steamships and one iron sailing ship proved to be safe.

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* Further details and a view of the steamer appear on page 310.—ED.

The Junior Institution of Engineers Welcomed to Germany.

PERHAPS the decision that Germany should be the location of the summer meeting of this society may have been regarded by some of its many friends as of too ambitious a character, but the great success of the gathering has justified in a most ample manner the Council's selection of the rendezvous. The members were received with the greatest kindness throughout the extensive tour, which included Dusseldorf, Oberhausen, Benrath, Elberfeld, Hanover, Berlin, Mariendorf, Charlottenburg, Leipsic, Frankfort-on-Maine, Hanau, Homburg, and the Rhine.

DUSSELDORF.

The proceedings opened on August 13th, when in the evening, at the fine Municipal Concert Hall at Dusseldorf, the civic authorities tendered greetings on the Institution's first entrance to the Fatherland. Associated in the ceremony as hosts were the Institution of German Iron Founders, the Lower Rhine District Association of German Engineers, and the Dusseldorf Institution of Architects and Engineers. Mr. Samuel Cutler, jun., M.I.Mech.E., the Junior Engineers' genial chairman, on this occasion and at at other times gave fluent utterance in German to the Institution's acknowledgments, as did also Mr. F. R. Durham, Assoc.M.Inst.C.E., of Frankfort-on-Maine, the indefatigable hon. secretary of the meeting. The following day was spent in an inspection of the Dusseldorf Exhibition, under the guidance of Mr. Emile Hess.

OBERHAUSEN.

Next morning an early train was taken for Oberhausen in order to visit the great iron, steel, and engineering works of the Gutehoffnungshutte. Two divisions were formed, one proceeding to the blast furnaces, steel works, and rolling mills, the other to the steel, iron and metal foundries, and engine and bridge works, etc. After being entertained to luncheon in the Works Club House, the members went on to the Benrather Crane Works—one of the largest of its kind in Europe—the methods of testing the various parts, systems of erection, and other details being fully explained to the visitors.

ELBERFELD.

On leaving Dusseldorf the party made for Elberfeld for the purpose of seeing the Langen Mono-rail Suspended Electric Railway, which has been described in the columns of PAGE'S MAGAZINE. The line now carries about 10,000,000 passengers per annum. Under the guidance of the engineers a complete inspection of the line was made, including car-sheds, power house (current is supplied from the municipal works), stations, etc.

HANOVER.

In the afternoon the members arrived at Hanover, where on the next day the first visit was to Messrs. Korting Brothers' Works, erected in the year 1871, and now giving employment to 2,500 hands. Here some special experiments with Korting injectors, steam jet elevators, condensers, blowers, pulsators, etc., were carried out. The importance of the heating engineering department of Messrs. Korting may be gathered from the fact that annually 5,500 tons of castings, 1,500 tons of wrought iron tubes, and 33,000 valves are made use of. Hospitable entertainment followed the visit, and the Hanover Engine Works were then inspected. They were founded in 1835, and have developed to such an extent that about 2,000 workmen are now employed. The manufacture of locomotives forms the principal work carried on, that department having been started in 1846. The total output to date has been close on 4,300, and forty engines can be fitted up simultaneously. The toast of the "Hannoversche Maschinebau" having been observed on leaving, the members then made their way to the Westinghouse Brake Company's Works, the construction and operation of the brake being fully explained, with the aid of an experimental apparatus such as is installed at the London depot, King's Cross.

The Hanover Gas Works were then entered, so that the Paris electro turbine gas retort charging machine might be seen at work. In carriages kindly provided by Mr. L. Korting, the engineer of the works, and President of the German Association of Gas and Water Engineers, the members subsequently had a most enjoyable drive to Herrenhausen.

Mr. Korting also acted as cicerone to the members on the following morning, when the Zoological Gardens, provincial museum, and other places were visited.

BERLIN.

In the afternoon came the journey to Berlin, which was reached at about seven o'clock. Friday morning was occupied by a most interesting visit to the Berlin Electric Overhead and Underground Railway. At the Students' Union Club at Charlottenburg the members of the party were entertained to luncheon by Messrs. Siemens and Halske, whose works were visited in the afternoon.

"SUMMER DINNER."

The Institution's Summer Dinner was successfully held in the evening at the Central Hotel, Berlin, the opportunity being taken for presenting to Mr. Durham a leather writing case, suitably inscribed, in expression of the members' appreciation of his valuable services as hon. secretary.

On the following day the Mariendorf Gas Works of the Imperial Continental Gas Association were visited in the morning, and the Royal Technical High School at Charlottenburg in the afternoon.

LEIPZIC.

On Monday afternoon, August 22nd, the party left Berlin for Leipsic, remaining there till Wednesday, when they went on to Frankfort-on-Maine. On the invitation and under the guidance of the engineer, Mr. W. H. Lindley, M.Inst.C.E., the Water and Electricity Works at Frankfort and the Sewage Works at Hanau were inspected.

The arrangements made for these visits were most excellent, and might well be followed in this country. Previous to the members going over each works, Mr. Lindley, with the aid of diagrams and drawings, gave a general description in the form of a short lecture.

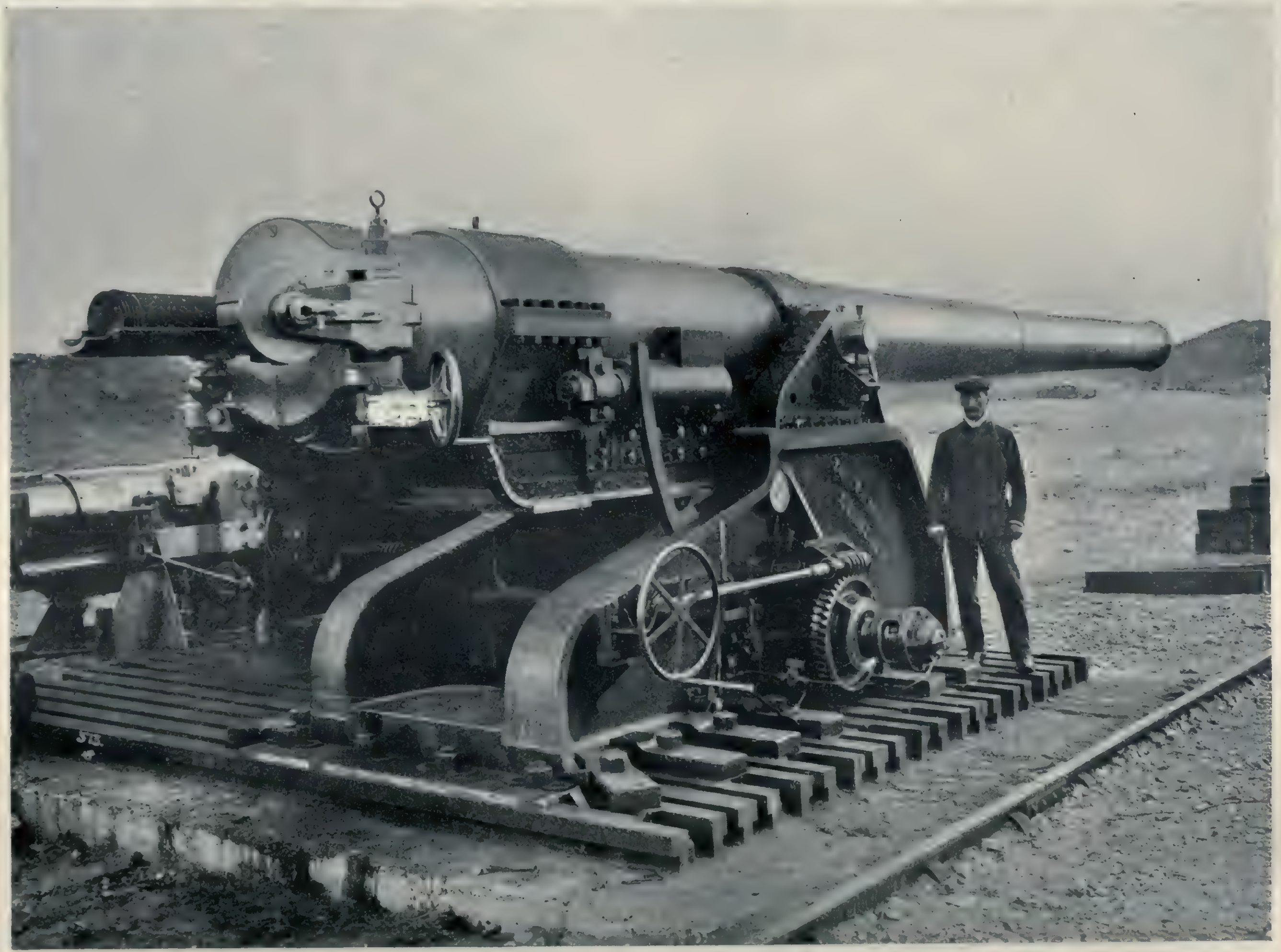
HOMBURG.

An excursion to Homburg took place on Friday afternoon, when the Director of the Baths conducted the members over the old and new buildings. Dinner was served in the evening on the historic Kurhaus Terrace, followed later by the fireworks of the Annual Summer Festival.

THE RHINE.

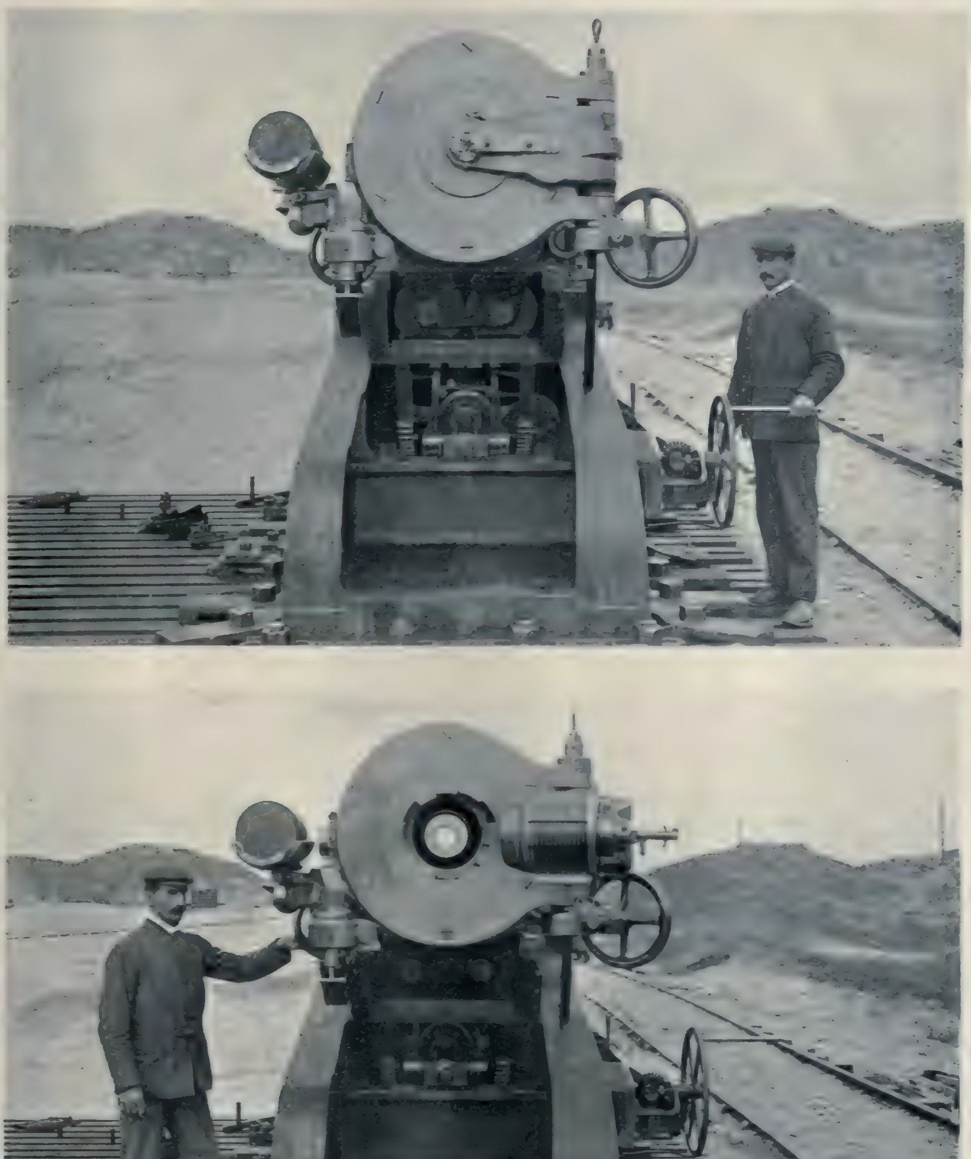
The next day the members travelled by train from Frankfort to Biebrich to join the Rhine express steamer for the trip to Bonn and thence by train to Cologne and so on to Flushing and England.

It should be mentioned that two extra visits were made, one at Berlin to Mr. W. Pittler's Experimental Works, and the other to Messrs. Pittler's Lathe Works at Leipsic. The cordial thanks of the Institution are due to the many German friends who assisted in making the Junior Engineers' visit so pleasant and instructive.



THE NEW 9·2 WIRE-WOUND BRITISH NAVAL GUN.

By the courtesy of Messrs. Vickers, Sons and Maxim, we are able to illustrate the latest type of wire-wound gun, which will be used on the



The above views clearly show the breech mechanism of the gun. The carrier for the shell is slewed round to breech at the moment of loading. The rate of fire is two or three shots per minute.

THE INSTITUTION OF MINING ENGINEERS.

FIFTEENTH ANNUAL GENERAL MEETING AT BIRMINGHAM.

THE fifteenth annual general meeting of the Institution of Mining Engineers was held at Birmingham on September 14th, Mr. James Cope Cadman in the chair. Among those present were :—

W. P. Abell, Duffield ; S. Alsop, Codnor ; R. S. Anderson, Armley ; T. Atherton, Armley ; F. R. Atkinson, Congleton ; W. N. Atkinson, Stoke-on-Trent ; T. W. Austin, Walsall ; J. Barrowman, Hamilton ; A. H. Bennett, Bristol ; G. J. Binns, Duffield ; H Bennett, Brough ; J. Walton Brown (secretary) ; J. B. Burns, Rugeley ; Prof. Burstall, Birmingham ; W. G. Chambers, Conisboro' ; Charles Chandley, Nottingham ; W. H. Chapman, Cradley ; W. Charlton, Walsall ; E. B. Clark, Sheffield ; W. F. Clark, Aldridge ; H. E. Coke, Nottingham ; T. J. Davies, West Bromwich ; W. H. Davies, Stoke-on-Trent ; C. C. Ellison, Barnsley ; H. C. Else, Sheffield ; D. L. Evans, Cardiff ; S. A. Everett, Nottingham ; George Farmer, Conisboro' ; T. E. Forster, Newcastle-on-Tyne ; G. C. Fowler, Cinder Hill ; J. W. Fryar, Mansfield ; W. E. Garforth ; M. George, Edinburgh ; A. W. Glazebrook, Dudley ; A. Greenwell, London ; G. Greenwell, Poynton ; J. Hamilton, Glasgow ; H. R. Hewitt, H.M.I. Derby ; Isaac Hodges, Normanton ; L. Holland, Hampstead ; R. Holiday, Pontefract ; H. W. Hughes, Dudley ; Prof. Hummell, Birmingham ; G. P. Hyslop, Shelton, Stoke-on-Trent ; H. Ingold, Sheffield ; D. Jackson, Newmains ; R. C. Jackson ; W. B. M. Jackson, Clay Cross ; H. Jeans, London ; H. Johnson, Dudley ; W. Kirkby, Leeds ; G. A. Lewis, Derby ; F. W. Llewellyn, Alsager ; Prof. H. Louis, Newcastle ; S. Lucas, Sheffield ; G. W. McCreath, Glasgow ; G. E. McMurtrie, Radstock ; S. Martin, Bristol ; S. Mason, Glasgow ; I. Meacham (President I.M.E. for South Staffordshire and East Worcestershire) ; F. G. Meachem, Dudley ; M. H. Mills, Mansfield ; R. T. Moore, Glasgow ; J. Morris, Cramlington, Northampton ; W. Morris, Newcastle ; A. Mount-Haes, London ; H. B. Nash, Barnsley ; J. Nevin, Mirfield ; J. T. Onions, Wolverhampton ; Davidge Page, London ; W. J. T. Payne, Pontefract ; H. C. Peake, Walsall Wood ; W. Randell, Birmingham ; Prof. Redmayne, Birmingham ; C. H. Robertson, Newcastle ; R. D. Robinson, Tanworth ; J. C. Roscamp, Newcastle ; J. Simpson, Heworth ; C. A. Slater, Sheffield ; Alexander Smith, Birmingham ; W. Smith, Ayr ; J. B. Sneddon, Mid-Calder ; Arthur Sopwith, Cannock ; S. L. Thatcher, Walsall ; J. J. Turnbull, Bengal ; T. Turner, Kilmarnock ; S. F. Walker, Bath ; W. Waterhouse, Bedworth ; E. Watson, Cannock ; W. H. Whitehouse, Walsall ; R. S. Williamson, Hednesford ; W. Williamson, Hamilton ; J. R. R. Wilson, etc., etc.

Members had the advantage of a central and well-appointed meeting place in the Anatomical Theatre of the University.

Mr. Bennet H. Brough (secretary of the Iron and Steel Institute) arrived with a large contingent of the Belgian Engineers, who had so lately enjoyed the hospitality of the Iron and Steel fraternity in London. A hearty welcome to Birmingham having been accorded to members on behalf of the South Staffordshire and East Worcestershire Association—

The President acknowledged the compliment, and proceeded to remark that as many of them were aware there was a number of Belgian engineers present. He then extended to them a hearty welcome to the meeting. At his request, Professor Louis conveyed the welcome to the visitors at some length, speaking in French.

M. Jules Magery, speaking from the President's right, acknowledged this courtesy, remarking that it was a source of intense gratification to his compatriots to make the acquaintance of so many distinguished engineers and to participate in the programme which had been so kindly arranged.

ANNUAL REPORT.

The Secretary (Mr. J. Walton Brown) read the fifteenth annual report, of which the following is an abstract :—

The six societies constituting the Institution of Mining Engineers are the same as last year, namely, the Midland Counties Institution of Engineers ; the Midland Institute of Mining, Civil and Mechanical Engineers ; the Mining Institute of Scotland ; the North of England Institute of Mining and Mechanical Engineers ; the North Staffordshire Institute of Mining and Mechanical Engineers ; and the South Staffordshire and East Worcestershire Institute of Mining Engineers.

A table exhibiting the progress of the membership since the formation of the Institution in 1889 shows that while in 1890 the members numbered, 1239, the present roll of the Institution is 2,704.

The Manchester Geological and Mining Society having applied to join the Institution of Mining Engineers from August 1st, 1904, their request was acceded to. The federation of this Society with the Institution of Mining Engineers will add a considerable number to the membership, and the inclusion of the papers read before that Society will materially increase the value of the *Transactions*.

Sir Clement Le Neve Foster was elected an honorary member of the Institution in February, 1904, and the council regret to report his sudden death. A vote of sympathy and condolence has been sent to his widow and family.

Prizes have been awarded to the writers of the following papers, which are printed in the *Transactions* (vols. xxiv. and xxv.) :—

"The Fernie Explosion." By Mr. William Blakemore.
"Sinking by the Freezing Method at Washington, County Durham." By Mr. Mark Ford.
"Miner's Anæmia, or Ankylostomiasis." By Dr. J. S. Haldane.
"The Marl Slate and Yellow Sand of Northumberland and Durham." By Prof. G. A. Lebour.
"The Occurrence of Gold in Great Britain and Ireland." By Mr. J. Malcolm McLaren.
"The Probability of Finding Workable Seams of Coal in the Carboniferous Limestone or Bernician Formation, beneath the Regular Coal-measures of Northumberland and Durham with an Account of a recent Deep Boring made, in Chopwell Woods, below the Brockwell Seam." By Mr. J.B. Simpson.

The papers published in the *Transactions* during the past year have been of a varied character, and the high standard of the *Transactions* has been well maintained.

The reports includes a detailed list which comprises sixty-one papers, and demonstrates the varied nature of the subjects dealt with in the *Transactions*.

THE PRESIDENT.

The announcement that Sir Lowthian Bell had accepted the presidency for the coming year was greeted with much applause.

MR. JAMES COPE CADMAN,
Retiring President.

A vote of thanks to the retiring President, Mr. James Cope Cadman, followed—that gentleman remarking that owing to the untiring work and co-operation of the Council, the office had been more a pleasure to him than a matter of hard work. He regretted the unavoidable absence of Sir Lowthian Bell, but hoped that they would have the advantage of his presence at the London meeting.

THE PAPERS.

THE MINING DEPARTMENT OF THE UNIVERSITY OF BIRMINGHAM.

THE place of honour was allotted to Professor Redmayne's paper on the above, which gave a full account of the scheme of mining education followed, and a detailed description of the mining equipment. The following is an abstract:—

SCHEME OF INSTRUCTION.

Mining is a very extensive and diversified subject ; indeed, in its entirety it may well be spoken of as an agglomeration of subjects, so the courses of instruction and study to be pursued at the university have been so arranged as to meet the requirements of those engaged in all or any of its different branches. The field covered by county council mining lecturers is in no wise trespassed upon, and it may be stated that no evening classes are held. Admirable work is being accomplished in the Midlands by the able lecturers appointed by the county councils ; the classes are large, and the students, in the majority of cases, enthusiastic. Some of the more advanced of the latter naturally proceed to the university, and constitute a very desirable class of students.

The full three years' curriculum has been constructed on the principle of giving a thorough grounding in pure science during the first two years (with instruction in the theory and practice of mining), and devoting the third and last year entirely to the application of the scientific knowledge so acquired to engineering: mining, mechanical, civil, electrical, and metallurgical—all specialising and research work in mining being relegated to a post-graduate or fourth year.

No mining laboratory practice during the first year, but a considerable length of time is given to laboratory work in the second and third years.

The summer school of practical mining takes place in every long vacation, the object being to devote several weeks in each year entirely to the detailed study of the plant and methods of working of a particular class of important mines, so that students may see for themselves in actual practice much that they have had described to them in the lecture theatre and classrooms. Questions are asked, problems discussed, notes taken and sketches made ; and the students are brought into close contact with the captains of mining industry, whose ranks they hope some day to join—in itself a wholesome experience. On the termination of the summer school the students prepare a report on all the work done, which they submit to the professor for his inspection. Last year's summer school was devoted to the study of the mining of clay-band and hæmatite iron ores of the North of England and the coal mining methods of Cumberland, Northumberland and Durham. This year the students specialised in gold, manganese, lead, and slate mining in North Wales, as well as carrying out a topographical survey and railway traverse for some miles through mountainous country. Besides the summer school numerous visits to the collieries and other mines of the Midlands are made during the session.

Underground surveying, and the modes of connecting surface and underground surveys will be carried out in the experimental mine, now nearly completed, which for this purpose alone will constitute a most valuable piece of apparatus.

The plan of the Applied Science Buildings at Bournbrook is so designed as to allow of allocating a separate block to distinct subjects, with a central hall common to all the sections of applied science. All the blocks radiate from, and are connected together by, a large semi-circular corridor. Each of these blocks is as large as Birmingham Town Hall. The latter building would go inside the central block. Besides these blocks, there are sundry outside buildings : the power-station, foundry, fitting shop, and the smelting section of the metallurgical department.

MINING EQUIPMENT.

The paper proceeded to describe the portion of the building—chiefly the basement floor of block C—assigned to mining, and the arrangements made for the museum, draughting-room, departmental library, class-room, small research coal mining laboratory, photographic dark room, and large coal mining laboratory. In the latter, many operations relating to coal-mining will be practically demonstrated and experiments carried out by the students, such as the construction and working of machine drills, coal cutting machinery, socketting of ropes, determination of the strength of materials (such as ropes, girders, props and wooden beams), and the construction and testing of safety lamps. Apparatus for all of these purposes are either now under consideration or being designed. Additional laboratory instruction and experimental research work will be carried on in the experimental coal mine placed outside the building.

The cross or end part contains (1) the large metal mining laboratory (the largest individual mining laboratory in the world), (2) a smaller or mechanical assay laboratory, in which instruction and experimental work will be carried out on a few ounces of ore at a time with small hand-worked apparatus, and (3) a general store room common to all of the mining laboratories.

A detailed description followed of the plant already under order, and being constructed by Messrs. Fraser and Chalmers, Ltd., of Erith.

ORE TREATMENT.

The plant in the large laboratory will be driven by electric motors, the power being conducted along cable laid from the power-house along a subterranean corridor. The power required will not amount to more than 20 h.p. in all.

The maximum quantity of water required will be about 200 gallons per minute, if all the large machines were going at once, but as this will never happen 150 gallons per minute, or even less, will be the most that is likely to be required at any one time. But as this is a very large amount of water, and more than it is desirable to draw from the city mains, it

Mr. C. REGINALD WINN.
(Messrs. Charles Winn and Co.,
Birmingham.)

Mr. A. MOUNT-HAES.
(The Humbolt Engineering
Works Co., Kalk.)

Mr. N. R. CHANDLER.

Mr. N. CHANDLER.
(Messrs. Bumsted and Chandler,
Hednesford.)

Professor F. W. BURSTALL, M.Sc., M.A., M.Inst.C.E , M.I.M.E.
(Professor of Engineering at the Birmingham University.)

MEMBERS OF THE INSTITUTION OF MINING ENGINEERS.

This group was specially taken upon their recent visit to the experimental mine and new laboratories of the Birmingham University at Bournbrook.

has been arranged, therefore, to use the same water over and over again, passing it through a settling tank of about 2,000 gallons capacity, and elevating it to a distributing tank by means of a pump. Using the same water over again, involves the use of muddy water for washing, but as the ore will also be used over and over again, this muddiness will not increase. This arrangement is being pursued in the mining laboratories at Columbia University, New York City, and Professor Munroe assured the writer that it had answered admirably. It is as well, of course, to treat but one kind of ore at a time, and to clean out all pumps, pipes and tanks before treating another ore, but at Columbia University this does not prevent them from using two or three machines simultaneously (on the same ore) if necessary.

The distributing mains will be large, some as large as 6 in. in diameter, in order to keep the velocity-head low at all times, so that the discharge remains practically constant at any faucet, even if several are open and closed on the same line.

An interesting section was also devoted to the experimental mine, but we omit this, as the subject is dealt with in a special article in the present issue.

A complete description of the engineering department was then given by Mr. Hummel.

CONGRATULATIONS AND CRITICISMS.

Congratulatory remarks followed by the Chairman, who thought that not only Birmingham, but the Midlands generally, must be very proud of the equipment described.

Mr. Mills called attention to the necessity of some arrangements being made for the housing of students at the University. He also regretted that nothing had been said as to the necessity of teaching mining men languages in what would undoubtedly be *the* Mining University of England.

Mr. G. J. Binns raised the question—Ought a student to attend the mining school before commencing work in the mine or afterwards?

Mr. W. N. Atkinson asked the older members to do all they could to urge those entering upon a mining career to take advantage of the University course, as it was only by increasing the scientific knowledge of members of the profession that they would be able to hold their own against foreign competitors.

After further discussion, Mr. Chandley emphasised the importance of the cost element. It was not the slightest use to have very clever engineers unless the coal could be got out at a price at which it would pay. This speaker said that what was wanted was the *demand* for trained men. There were no more conservative people than colliery owners, and it seemed to him that those were the people they had to educate. There was not the demand there ought to be for efficiently taught men, and the sooner colliery owners recognised this the better.

Mr. Sydney F. Walker afterwards addressed the meeting at some length. There was, he said, a strong feeling that the Americans and Germans had got ahead of this country because of their advance in technical education. In future they would be better able to cope with that, especially as the mining section had been laid out on practical lines. It appeared that his experiences of technical students in electrical work had not been most satisfactory. He considered that technical colleges very largely crammed students with a number of useless facts and figures. He was glad to see the inclusion of a refrigerating apparatus in the department, though it was only a small one. He believed it was the only teaching body possessing such an apparatus. Cold storage was rapidly growing, and was affecting almost every industry. It would, in future, help mining engineers very considerably to solve many awkward problems underground.

Mr. Martin said he would regret any remarks which might be taken to deprecate scientific education, as he realised that by their training and the application of practice to theory, the Germans had got ahead of us. He hoped to see England holding its position, and not falling behind in the race.

Several other points were raised, one member suggesting that the mining courses arranged should be so elastic that students might have the opportunity of spending part of the week at the actual pit mouth.

Professor Louis offered hearty congratulations to Professor Redmayne and the Midlands on the acquisition of the excellent equipment that had been described, though as regards the curriculum, there were many points on which he differed from him. In the course of further remarks, he emphatically laid it down that no man should be allowed to teach mining until he had had a good many years' practical experience in the management of mines. He took emphatic exception to Mr. Hummell's statement that the engineering course was intended to equip students so as to make them *at once* serviceable at engineering works. This he thought was impossible, and if it were possible, it would be inadvisable.

A hearty vote of thanks for the paper having been passed, Professor Redmayne replied at some length, agreeing heartily with the suggestions *re* the housing of students and the teaching of languages. With regard to the latter, the difficulty was to get everything into the three years' course. Eventually they would have a four years' course, and then, of course, languages would be included.

With regard to a suggestion that some of the machinery might become obsolete, he explained that it was proposed to have a hall of machines, in which machinery lent by manufacturers would be constantly passing through. Referring to the point raised by Mr. Binns, he said his own personal leaning was to the plan of letting the student have a year's practical experience at a colliery before going to a university. He entirely agreed with Professor Louis as to the necessity of practical experience for teachers of mining, and had himself spent many years in the mine.

COAL MINING IN ASTURIAS, SPAIN.

PROFESSOR HENRY LOUIS, M.A., A.R.S.M., F.I.C., in the above paper presented some out of the way facts concerning a little-known mine. An abstract of the paper was read by the author, which enabled the lunch interval to be reached in reasonable time:—

The province of Asturias is, as is well known, the most important coal-mining district in Spain. One of the most important coal-fields is that traversed by the River Nalon, which, rising among the northern flanks of the Cantabrian mountains, flows swiftly in a north-westerly direction.

The coal-measures in the above field consist of alternations of firm shales, sandstones of moderate hardness and limestones, with numerous coal-seams, usually from 2 ft. to 6 ft. in thickness, lying at steep angles ranging from 30 deg. to 60 deg. to the horizontal, these strata constituting the lowest members of the carboniferous formation. The coal is a good bituminous coal, and fairly hard and clean.

The mine selected for description is one of the smaller mines of the district, and is situated near the village of Polo de Laviana, the methods of working being somewhat more primitive than those in use in some of the larger collieries. Owing to the Spanish laws which control the granting of mining concessions, it is usually difficult to secure large royalties, and the one in question contains only some 2,300 ft. (700 metres) along the strike by 2,300 ft. (700 metres) along the dip of the seam. There are two seams, only one of which is being worked at present, the total amount of coal existing in the royalty being estimated at about 1,000,000 tons. The seam being worked averages about 3 ft. in thickness; it pinches to about 1 ft. in places, but in others it is fully 4 ft. thick; the floor consists of a firm hard fireclay, the roof of a firm strong shale that stands well as a rule, but is treacherous in places, tending to come away from a thick bed of sandstone, some 26 ft. above it. The other seam averages 2½ ft. thick, has a very bad roof, and is 200 ft. below the first-named. The dip is 30 deg. to 35 deg. to the north-west.

The output of the mine is about 50 tons of coal per working day, but exceptionally up to 70 tons per day have been produced.

Only natural ventilation is employed, and no means appear to be used to direct the air-currents; the latter are feeble, but appear to be sufficient. No gas has ever been seen; the levels are tolerably damp, but the working-faces are comparatively dry; the coal, however, does not make much dust. Naked oil-lamps of the universal Spanish pattern, fed with olive-oil, are everywhere used, one or two safety-lamps being occasionally employed for testing purposes.

The average cost of the coal, everything included, in railway wagons, is said to be about 8 pesetas or 5s. 4d. per ton. The selling prices per ton on rail at the mine are said to be as follows: Lump coal, 24 pesetas or 16s.; nuts, 23 pesetas or 15s. 4d.; washed smalls, 18 pesetas or 12s.; unwashed smalls, 12 pesetas or 8s. It will be seen that whatever criticisms may be directed at the technical aspects of Asturian coal-mining, its financial results can only be regarded in this country with feelings of profound envy.

The author was heartily thanked for his paper on the motion of Mr. Brough, who noted the value of putting on record out of the way details of the kind included in the paper. Mr. Brough related some of his own experience in Spain, where olive oil had been used as described. He found the item of olive oil a considerable expense, because the miner would insist on drinking it. They tried petroleum, paraffin, and all sorts of things mixed with it, but the liquid continued to disappear at the same extravagant rate, the miner using oil indiscriminately for his lamp, his hair, and his dinner. (Laughter.)

Professor Louis subsequently explained that in Asturias this did not affect the cost of working as the men provided their own oil.

MEMBERS OF THE INSTITUTION OF MINING ENGINEERS RETURNING FROM THE VISIT TO SIR ALFRED HICKMAN'S IRON AND STEEL WORKS.

Mr. Alexander Smith, M.I.C.E., Hon. Sec. for Institution of Mining Engineers' Birmingham Meeting, Sept., 1904.

Prof. R. A. S. Redmayne, M.Sc., M.E., F.G.S., Professor of Mining, Birmingham University.

Mr. K. C. Jackson, of the British Thomson-Houston Co., Ltd.

Mr. J. S. Martin, H.M. Chief Inspector of Mines for Southern District.

Mr. Thos. Bailes, Mining Engineer, Newcastle-on-Tyne.

THE PROBLEM OF GOB-FIRES.

AFTER the lunch interval a long but valuable paper with the above title was read by Mr. George Farmer.

The writer shows that the laws of the atomic theory and the laws of combining proportions are very closely associated with the reactions of the gob and gob-material; that a definite quantity of mechanical energy is equivalent to a definite quantity of heat; and that oxygen is present in the goaf, and carried in from such sources as the chemical constituents of the material, the air, moisture, etc. There are thus three conditions necessary for spontaneous combustion, a combustion which would result in a fire.

Coal absorbs oxygen quickly, and more quickly as the surface open to oxidation increases, and as the heat increases; so that, any cause which will split up the gob-material will aid in initiating a fire. Moisture assists the oxidation and heating by splitting up the gob-material, so that this may be considered an important factor.

The depth from the surface, with the peculiar conditions attached to each colliery separately from others, may influence the liability of the seam to spontaneous combustion; hence, as the workings become deeper, and the normal temperature of the mine is increased, there will be greater risk of the occurrence of these fires.

In every case in which a fire has been properly located, props left in the goaf, or ribs of coal left against faults, or falls in working stalls burying a rib of coal have been found to be the origin. Hence, a good deal in the way of preventing these fires depends to some extent in the management of the collieries; and in oxygen being allowed to percolate into the goafs in such quantities as to breed fire.

In any method of extinction, means must be taken for cooling the hot material, by the application of substances which will absorb the heat and reduce its temperature to such a degree that combustion entirely ceases in a natural atmosphere; or by the removal of the combustible material from the influence of the heat.

EXTINCTION.

Although the means adopted for preventing gob-fires may lessen their extent and frequency, yet it is not always possible to prevent them. As the present coal-seams become worked out, it will be clearly inevitable to resort to seams lying at a greater depth, leading to enhanced difficulties of working, one of which will be increased liability to gob-fires; and recourse will have to be made to different methods of extinguishing these fires under the different and difficult conditions then encountered. Time is the most important factor, and precious moments wasted may mean failure; if the fire is given time to spread its extinction will become more difficult, and may entail the closing of a section of the mine, or of the whole colliery.

STOPPING THE FIRE.

The object of this method is to isolate the portion of workings on fire, and to prevent the access of air to the fire. After deciding on a line, with the fewest number of openings crossing it, air-tight stoppings or barriers are built in each of these openings. If the air can be effectually kept from the fire in this way, it may soon extinguish itself, but it is not always possible to close all crevices. In some instances, fires have been sealed, and, upon the place being re-opened, the fire was found to have been extinguished; whilst other fires have been sealed, and although the fierceness of the fire has been apparently killed at the time, as soon as the air has again been admitted, the smouldering fire has again burst out in fury. Very divergent opinions exist as to how long it is necessary to seal off a gob-fire before it can be re-opened. Sometimes, it has been found necessary to close the shafts by putting scaffolding in them, but this method is liable to give the idea that the fire is sealed off, when it is not sealed; and it is not a good method.

DROWNING OUT THE FIRE.

This method is very effectual where it can be adopted, and may be accomplished by stopping the pumps and allowing the water to rise, or by sending water down from the surface. This method is, however, very costly, for the water has to be pumped out after the fire has ceased, whilst the deteriorated condition of the strata and coal makes its adoption a last resource. It is an undesirable method where the roof and floor is of a softish or of a clayey nature; and the moistened coal is very liable to again take fire.

CARBONIC ACID.

This gas can be produced in large quantities by the action of hydrochloric acid on limestone, and then conducted through pipes to the seat of the fire; the seat of the fire being made practically air-tight by the means of stoppings. This gas has the decided advantage over water of not injuring the workings, and, mixing with fire-damp, reduces the danger of explosion. Its use does not seem to be advantageous, however, for, while it has been used effectually in some cases, Mr. W. H. Chambers* states that, in the case of a colliery near Rotherham, where the shafts were sealed and carbonic acid was passed through the stoppings, it was found that the gas merely suspended the burning, which broke out as badly as before when air was re-admitted.

FILLING OUT THE FIRE.

The most effectual method, and in the end the cheapest as well as the safest, is that of driving into the goaf and filling out the material that is on fire; and for the complete extinction of gob-fires this is the only efficient method, as the danger of the material again becoming ignited is avoided by its being sent to the surface. The method of filling-out has been resorted to, and has been the means of completely extinguishing many fires at the Denaby Main colliery. A full description of this method of extinction has been given by Mr. W. H. Chambers.† The difficulties are often very considerable, for, while air is especially necessary for the workmen on account of the great heat and the poisonous gases evolved, yet such air helps to increase the combustion.

A hard-and-fast rule cannot be adopted for the extinction of gob-fires, as each district worked under their own peculiar conditions, and each gob-fire must be dealt with on its own merits.

In summing up the long discussion, the President remarked that there was no royal road in dealing with this question. The observations of the various speakers showed the truth of the statement that each fire must be dealt with according to the peculiar circumstances of the case.

Mr. Farmer received a cordial vote of thanks.

THE BENGAL COAL FIELDS AND SOME METHODS OF PILLAR WORKING IN BENGAL, INDIA.

A PAPER packed with facts and figures was then presented with the above title by Mr. George A. Stonier, A.R.S.M., F.G.S., who in his introductory remarks says:—

The coal-output of India has wonderfully increased during the last twenty-three years. In 1880, only 1,020,000 tons were raised; while for 1903, the output totals 7,374,000 tons, valued at 21,754,000 rupees; and the industry employed nearly 88,000 persons daily. Coal-bearing strata in India are of varying geological ages: Cretaceous and Tertiary beds yielding 4½ per cent.; and the Gondwana beds (Permo-Trias), 95½ per cent. of the output of this mineral.

In 1903, the province of Bengal furnished nearly 6,298,000 tons (or 85½ per cent. of the total output for India) entirely from the Gondwana beds, which may be conveniently divided into an Upper Coal Series (or Raniganj of Blanford) and a Lower Coal Series (or Barakar of Blanford). The former yielded 2,230,000 tons, and the latter contributed 4,068,000 tons. Four companies mined 31 per cent. of the production, 82 per cent. was mined from European, and 18 per cent. from Indian owned collieries.

METHODS OF PILLAR WORKING.

At most of the pits, the roof is good, the floor and coal are hard, and the dip is small. Gas has been detected in small quantities at five collieries. One seam is 95 ft. thick, and the portions worked vary in thickness from 2½ ft. to 45 ft. Longwall working was attempted some years ago in the Raniganj coal field, but it was discontinued.

As a rule, a quarry is commenced at the outcrop; and as it pays to remove a large overburden from thick seams, a number of huge open excavations have been formed. When the cover overlying a seam is too thick to be economically removed, or when the seam is thin, gallieries, from 8 ft. to 12 ft. wide, are driven, both on the dip and along the strike of the seam. It is usual to start from the top of the seam with a height of 6 ft., and after this drive has advanced some distance, to deepen it to the full height of the seam, by cutting out the remainder of the coal in successive steps. The pillars of coal, left between the galleries, vary from 12 ft. to 40 ft. and occasionally are 100 ft.

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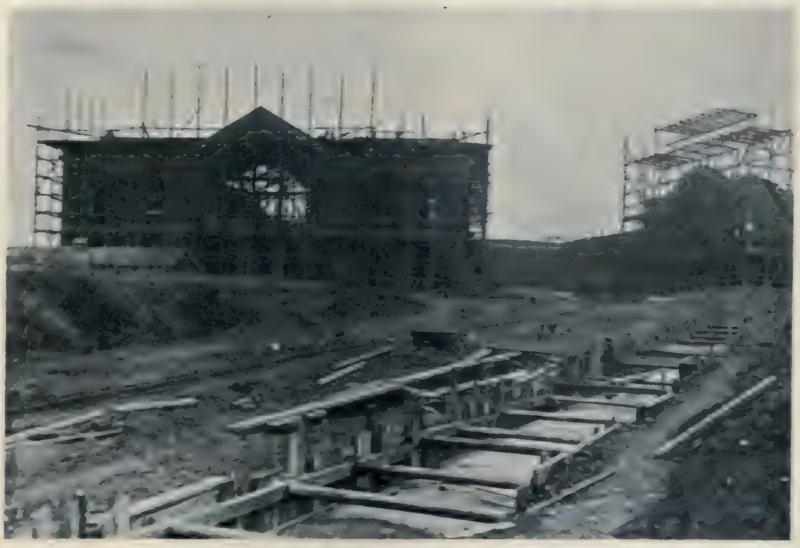
* "Notes on Gob-fires," by Mr. W. H. Chambers, Trans.Inst.M.E., 1899, vol. xvii., page 154.

† *Ibid.*



(1) View of buildings in course of construction at the Birmingham University, Bournbrook.
(2) Members of the Institution of Mining Engineers at Sir Alfred Hickman's Iron and Steel Works.

square, the larger pillars being left in the case of thick seams or thick cover.

The paper occupied the attention of the meeting for a considerable time, and was discussed at length. the author receiving a hearty vote of thanks.

The remaining papers were taken as read.

AN IMPROVED APPARATUS FOR LAYING DUST IN COAL MINES.

THE following is an abstract from a paper on the above subject by Mr. J. Cresswell-Roscamp.

Many attempts have been made to water and lay the dust on the roads, sides, and timbers in coal mines, and methods have even been introduced and brought before the members claiming to prevent the accumulation of the dust. However, no apparatus hitherto devised for this purpose has been entirely satisfactory in efficiency and practice.

One method by which this has been effected is an improved watering tub, which, in outward appearance, is similar to an ordinary colliery tub. The mechanism is simple, consisting of two small pumps, with cylinders 3 in. in dameter by 2 in. stroke, and an air cylinder 7 in. in diameter and 14 in. high, driven direct from one axle of the tub and connected to three sprayers or nozzles fitted so that either one or all may be used. In this simplicity of construction there are several advantages, as no packing is required, there is no gearing to get out of order, and, in fact, the whole contrivance is readily handled and easy of access. The action is as follows: The water (or other liquid) is forced by the pumps into the air cylinder, which causes a regular and unpulsating column to flow along the pipes and out of the nozzles. These sprayers or nozzles are fitted with a specially constructed screw apparatus round which the liquid is forced, and which gives the spray a circular momentum reaching a breadth up to 30 ft. The sprays, thus emitted, are in the shape of inverted cones impinging on each other and becoming so completely atomised and aerated that they in reality become a vapour. This vapour is carried along by the air current and can clearly be felt from 100 ft. to 150 ft. behind the tub when it is in motion. In this way, therefore, the whole surface of the roadway is damped, and as will readily be perceived, the spray, assuming the shape and nature as it does, is able to damp all surfaces approached both in front and behind. Where water is applied with any force on dust that is thoroughly dry it runs off with the finer dust in the form of spherules and then becomes a means of raising the dust rather than laying it. The spray being thus atomised should not have any ill effects on the roof, floor, or sides of the roads.

The tub will travel and do its work quite as efficiently by any means of haulage, be the system main and tail, endless rope, or horse; and it is quite as easily moved along by manual labour as an ordinary tub. The liquid sprayed need not necessarily be water, and lime water, whitewash, or any other preservative of timber may be ejected in a similar manner. A tub of ordinary size will contain sufficient liquid to lay the dust over a distance of between one and two miles of roadways. A tap is fitted to the pipe connecting the pumps and the nozzle, and when this is turned the liquid flows back into the tank instead of out of the nozzles, when a spray is not desired.

The results of a few personal experiments are appended to the paper, fully justifying the assertion that the imminently dangerous properties of coal-dust are minimised to an infinitesimal quantity by the treatment it affords.

THE PRINCIPAL GOLD-MINING DISTRICTS AND MINES OF WESTERN AUSTRALIA.

SOME valuable notes on the above were presented in a paper by Mr. W. T. Saunders :—

The town of Kalgoorlie is the principal gold-mining centre; and the most successful and largest mines are for the most part situated in the vicinity of Boulder, a small township about three miles south-east of Kalgoorlie on a stretch of country known as the "Golden Mile." On this stretch are three distinct belts of ore, two running parallel (direction, about south 45 deg. east and north 45 deg. west) known respectively as the west belt and the east belt, and the third the well-known Oroya chute which runs at a very easy gradient in a southerly course ranging in width from a few feet to 200 feet, and in thickness from a few feet to 20 feet, and having an average value of about £1,500 per foot run. In the last-named belt the payable ground lies between the North Kalgurlie and Lake View Consols properties inclusive, and in the west belt between the Ivanhoe and Hannans North Star properties inclusive. The lodes or bodies of ore in both belts are lenticular in form and can best be described as similar to strings of beans one under the other; they are therefore of very varying thickness, varying from a few feet to 20 feet and more. The west belt comprises four and the east belt two main lodes: the formation being diorite. The principal mines on the west belt are Ivanhoe, Great Boulder, and Golden Horseshoe; on the east belt, Lake View Consols, Great Boulder Perseverance, and North Kalgurlie; and on the Oroya chute, Brownhill, Associated Northern, and Oroya Brownhill. The ore on the west belt is to a certain extent free milling, the free gold contents running about 40 per cent. of the total, but in the east belt and the Oroya chute the gold values are mostly contained in the telluroid, and very little free gold is caught. Kalgoorlie, the principal town, is situated about 300 miles by rail from Fremantle, the port of call for Western Australia of the different lines of mail and other steamers. It is a fine modern town with a population of about 30,000 inhabitants: it has fine up-to-date buildings, electric trams, electric light, etc. The climate in summer is hot and dry, the temperature running up to 112 deg. F. and over in the shade. The heat, however, is not particularly oppressive, being dry, and, speaking generally, the people look well and healthy. In winter the climate is said to be perfect. The greatest inconvenience is caused by the dust, and when there is a high wind it is very unpleasant. Until recently the great trouble was the want of water, both for mining and other purposes. The water obtained locally in the shafts, wells, etc., being salt, had to be condensed, and was consequently a costly item. This trouble, however, has been removed, and the district is now well and plentifully supplied with water by a pipe line from Mundaring: distant about 280 miles.

Mining claims are leased from the Government for 21 years, and can be surrendered or renewed (practically speaking) at will. The cost of leasing mining claims is £1 per acre per annum. One lease must not comprise more than 24 acres, if more than this area is required a separate lease for each block of 24 acres or portion thereof must be taken out. No royalties are demanded until the property becomes profitable, and then the Crown exacts 5 per cent. of the profits, or, in the case of a company, 5 per cent. of the dividends paid.

The wages paid in the district per day of eight hours are as follows: Men working machine drills, 13s. 4d.; day miners, not working drills, 11s. 8d.; and truckers or trammers, 10s. 6d. For contract work the following rates may be taken as a fair average: (1) Sinking a vertical shaft, 13 ft. by 5 ft., £7 10s. per foot, the men finding their own fracture, or explosives, and the company finding drills, tools, etc., and giving "clearance," that is truckers. On this work the men would make about £1 per day of eight hours. (2) Sinking a winze, £3 10s. to £4 per foot. Cross-cuts, in country rock, 7 ft. high by 5 ft. wide, £1 14s. per foot; and on the lode, £1 18s. to £2 per foot, the men finding "fracture" and the company drills, tools, and "clearance." In declaring the monthly crushings the mines under the management of Messrs. Bewick, Moreing and Co. use the ton of 2,000 lb., and all other mines the ton of 2,240 lb.

Gold values may prove very misleading, as some mines declare their produce as fine, others as standard, and others as bullion of varying sterling value. The writer thinks it would simplify matters if a uniform method were adopted, such as declaring value of ore reserves, gold yield, etc., in sterling value—a method usually adopted in America. It is understood that the Government have this matter under consideration, and probably a uniform method of declaring monthly crushings, yield of gold, etc., will be adopted. Fine gold is worth £4 4s. 11d. per ounce.

The former scarcity of water necessitated the mines being very economical in its use, and for this reason several dry-crushing plants were installed.

The principal mines crushing wet, in the ordinary way, with stamps, are the Ivanhoe, Lake View Consols, Oroya Brownhill, Golden Horseshoe, etc., and those using the dry process, the Kalgurlie, Associated, Associated Northern Great Boulder Proprietary, Great Boulder Main Reef, and the Great Boulder Perseverance: the first three mines are using ball mills, and the last three Griffin mills.

THE PROBLEM OF DYNAMIC BALANCE.

THE following extracts are from Mr. E. H. Roberton's paper on "The Problem of Dynamic Balance":—

The probability of the extensive exploitation in the near future of the deep coal measures of the midland district of Great Britain, the extent and resources of which may prove of vast magnitude and importance, renders this investigation especially interesting and valuable to the mining engineer of the midlands, as on the suitability of his winding plant to perform economically and efficiently the work allotted to it may depend the success or failure of the whole scheme. The solution thus constitutes a vital issue in deep colliery practice.

Increase of output combines with increase in depth to impose on the capacity of the winding engine a tax, which is at the commencement of the wind far in excess of the average power required over the whole period of winding, and very much further in excess of the power required towards the latter portion of the wind, before the brakes are applied.

The whole operation of winding divides itself into three natural periods, the periods of (*a*) acceleration, (*b*) constant speed, and (*c*) retardation, though in pits of moderate depth the middle period is often non-existent. The increase in depth, then, and the greater masses to be accelerated (load, cages, chains, ropes, pulleys and drum), as well as the increase in acceleration to ensure a sufficient rapidity of winding, involve a vastly augmented demand for power from the engine at the beginning of the trip. It is a practice much in favour to effect this result by the use of a pair of compound engines, which are constructed so that at the commencement of the wind the high-pressure steam may be turned into the low-pressure cylinder, and the high-pressure cylinder exhausted into the atmosphere, the engines being run expansively after the maximum speed is attained. The chief aim of the engineer being the creation of a high velocity in a short period of time, leaving the rest of the trip practically to take care of itself, the engine therefore is built with a view of creating a fairly large acceleration at the outset, and left to do work during the greater part of the wind (especially if the ropes are unbalanced) which is far below its capacity; indeed at the end of the trip it is often called upon to assist the brakes in destroying the stored-up energy supplied by itself to the moving masses.

A serious consequence of the employment of a large engine of this type, with its intermittent demand for short bursts of power, is the effect on the boiler plant, which must be of more than ample capacity in order to supply large periodic quantities of steam with brief intervening spaces of comparative inactivity. In a mine of considerable depth the winding engine will be of such a size that unless there be an adequate boiler plant to admit of the withdrawal of large quantities of steam periodically, without too much temporary loss of pressure, other engines depending on the same boilers for their supply of steam will suffer. The want of economy caused by the expenditure of capital upon a battery of boilers of comparatively abnormal capacity is exaggerated whenever the engine ceases winding temporarily, to enable repairs to be carried out in the shaft, or for some other reason, by the excessive loss of steam from the safety valves.

The effect of substituting multiple stage for single stage winding is, in general, not so much a reduction of the average horse-power required from the engine (though it does reduce it) as a means of lessening the difference between the power required at the commencement of the wind, and the average power required throughout the wind.

Stress has been laid by many practical men on the advantages to be gained by counterbalancing. This has been practised for many years in mines of moderate depth, whose plant was laid down before the days of high pressure steam. The advent of this latter obviated the pressing need for counterbalancing, which went out of use; but the increase in depth of mining with its greater length of winding rope, has again brought before engineers the advantages to be gained by its adoption. Methods of balancing that have done, and still do useful work, are the chain balance, the attachment of a tail rope beneath the cages, the spiral drum, and one or two other systems that have received a trial, such as the Després, and the Camphausen method. In all cases, however, engineers have merely aimed at countering the weight of the unbalanced winding rope, and have in many instances stopped short even of this.

We have seen the marked discrepancy between the power required from the winding engine during the acceleration period, and the average power required throughout the wind. If some means were devised of spreading this great initial power over the whole trip, or, in other words, to take the energy which is accumulated in the moving masses at the time of highest velocity, and apply it at the beginning of the trip, and (of necessity) to apply it negatively at the end, the power required from the engine would be nearly uniform during the greater part of the wind; also the brake-power required to stop the masses in motion would be comparatively small. The solution of this problem should not be beyond the ingenuity of the present-day mining engineer. The economical results would be great, both in the first cost of the engine and boiler plant, and also in loss from wear and tear.

The most obvious solution that suggests itself is the adoption of overbalancing. In the case of the ordinary winding process, with a cylindrical drum and unbalanced ropes, the position of equilibrium occurs when the full load is somewhere near the top of the shaft, either below it (actual), or above it (virtual), and the greates static load is at the start. In the case of the balanced rope, there is no position of equilibrium, and the static load is constant throughout the wind. In the case of the overbalanced rope and load, the position of equilibrium would be when the full load is somewhat below the centre of the shaft; the static load at the commencement would be in favour of the engines, while after passing the position of equilibrium it would be against the engines, and constantly increasing.

The Koepe sheave system of winding could, to a limited extent, be easily applied to this end, by simply hanging beneath the cages a rope of heavier make than the winding rope, or perhaps two or more ropes instead of one. A great advantage obtainable from this would probably be the complete prevention of the slipping of the rope on the sheave (which seems to be the main objection to this method of winding), as the slip obviously takes place when the engines, or the brakes, are exerting their maximum of power, therefore the equalising of the power exerted by the engine, and the assistance given to the brakes, will tend to the entire prevention of the slip.

Any attempt to effect a solution of the problem of dynamic balance which involves the employment of an intermittently running engine, can at best attain only partial success, as it is evident that between the operations of winding uniformity of power-demand is destroyed. The ideal contrivance will attain this end by employing a steadily running engine, and storing the power by some method of accumulation, electrical, hydraulic, or pneumatic; or possibly some combination of a direct winding engine and a power accumulator.

Of the three forms of power storage, the hydraulic may be dismissed as for practical reasons being unsuitable for the high-speed work necessary in deep shafts. The only obvious method of its application namely, substituting an equivalent weight of water in the empty cage for the constant turning moment required by the engine in the overbalanced Koepe sheave arrangement above described, or some similar contrivance fails in an emergency, when a greater turning movement is required than can be exerted by the water weight. The solution of the problem of dynamic balance, however, would be perfect in this case if it were only practicable, as the main pumping engine would deal with all the pit water at the same time, working steadily day and night.

It is highly probable that we have not seen the last of the pneumatic system of hoisting, invented by Mr. Blanchet. Its advantages in connection with deep shafts are numerous. The method can be practised with as great facility in mines of enormous depth as in shallow mines, and the winding rope, which in a deep mine is a very expensive item, and a constant drain on the resources of the concern, is entirely dispensed with. A heavy load can be dealt with at each trip, and the speed of the cage, especially in the descending trip, is almost unlimited.

This system, besides apparently possessing many unique advantages for the purposes of deep mining, offers a neat solution of the problem under consideration. There seems no insuperable reason why the engines should not be kept running steadily through the whole working day. The air in the tube at the beginning of the hoist would be in a higher state of rarefaction than at the end (when it could be automatically compressed if necessary, to stop the motion of the cage). This seems to suit the case exactly, as the arrangement exerts the greatest power just when it is needed, the power exerted gradually diminishing as the operation of winding progresses.

There remains to be discussed the question of the electrical accumulation of power. Economy in the application of electricity is best gained by the use of a central generating plant which does duty in electrifying many large works distributed around it. That this system of power centralisation will be extended to mine works there is little doubt. Professor R. A. S Redmayne gives as his opinion that the great mining concerns of the future will be supplied with power from a central generating plant driven by producer-gas engines, and that possibly three or four different mining companies will join forces to build a common generating plant which shall supply them all. The colliery of the future that he looks forward to is one which, by means of three or four shafts, shall produce a daily output of 12,000 tons; the power required being perhaps 25,000 horse-power.

The economy attained by this eminently cheap form of power generation will be very considerable, it being stated that the virtual consumption of coal in a producer-gas engine is as low as 1 lb. per horse-power hour.

The form of motor used for winding may be of the three-phase type, or of the continuous current type. A great advantage, which ever form is used, is that the speed at which they run varies extremely little whatever the load may be, even if there be a negative load. The small variation in the working speed of electric motors at first led to the idea that they could only be run economically at the speed and load for which they were designed, and that therefore for winding purposes which demand very varied conditions in both speed and load, they would prove unsuitable. But, according to Mr. Irvine, an electric motor can not only take 50 per cent. overload in starting, but can now also be built to run at 20 per cent. of the full load without the efficiency falling off more than from 7 to 10 per cent. In these respects, therefore, electric motors compare very favourable with steam engines.

With regard to the economy gained by the use of electrical hoisting machinery, electrical engineers claim that with an up-to-date generating plant the coal consumption is brought down to less than 40 per cent. of its original value. The steam consumption of electrical winding engines, according to Mr. Paul Habets, varies from 31 lb. to 42 lb. per horse-power hour of useful work.

As the dynamos are continually giving out energy, whether the motors are running or are at a standstill, the energy generated when the motors are idle is in some cases stored in secondary batteries, to be afterwards used in giving the required motion to the masses of the mineral, cages, etc., a condition which approaches very nearly to the solution of the problem of dynamic balance. This, however, besides being only applicable to continuous current motors, involves many complications, especially if, as is really necessary, devices for an increased torque at starting are employed. The secondary batteries themselves, too, possess many inherent disadvantages and defects, rendering this system of power storage impracticable.

This is well exemplified in the case of the engine now in operation at the Zollern II. colliery, and formerly exhibited at the Düsseldorf Exhibition. The expense and complexity of the secondary batteries and switching gear led to the abandonment of this form of storage and to the adoption of Mr. Ilgner's simpler method of accumulation of energy in a high-speed flywheel. That the inventors have every confidence in this new device is clear from the fact that winding engines of a total capacity of 17,000 horse-power were being constructed in the earlier part of this year for various mines, before having been put into practical operation anywhere. A special advantage of this contrivance is that not only can it be used for a continuous current installation but also for alternators, provided each winding engine has its own generator.

It is said that the kinetic energy stored in one of these flywheels is sufficient in itself to give out power for several trips, in case the main supply should be cut off. At first sight it seems strange that electricians should fall back on the mechanical idea of flywheel rotation for the purposes of power storage, and one is inclined to ask if this device could not be adapted to steam winding engines, without the necessity of previously converting the steam power into electricity.

Another paper on the programme was "Mine-Surveying Instruments, Part II.," by Mr. Dunbar D. Scott.

VOTE OF THANKS.

ON the motion of Mr. Brough a vote of thanks was tendered to the Council of the University of Birmingham for the use of the room, and to the owners of the works to be visited in the district. Votes of thanks were also passed respectively to the South Staffordshire Institute (coupled with the name of Mr. Alexander Smith) for the excellent arrangements made for the meeting, and to Mr. James Cope Cadman, for his able conduct of the business.

THE ANNUAL DINNER.

THIS function, presided over at the Grand Hotel by Mr. I. Meacham, was rendered more interesting than usual by reason of the invitation which had been extended by the Institute to the Association des Ingénieurs Sortis de l'Ecole de Liége."

Following the customary loyal toasts, Mr. O. S. Martin proposed the "Institution of Mining Engineers," referring to its steady growth, and congratulating them upon the latest addition—the Manchester Geological Society—an institution which had done very good local work. He considered that it was of great advantage that the work of the several districts should be bound together in one volume of "Transactions." By that means those who lived in different districts became acquainted with what was passing and what was being done in other districts. He hoped that the progress of the Institute would continue, and that in time the South Wales people would become federated. He pointed out that in former times the Institute was practically responsible for the technical education in mining of this country, and expressed the hope that although technical education had been introduced on a different and much larger scale, the Institute would continue to encourage it in every way it possibly could. He thought that not only should there be technical classes locally in places like Birmingham, Newcastle, London, and Cornwall—but that there should be mining schools in all centres where, if they did not give the highest form of technical education, as in places like Birmingham, they might give an education suitable to the unofficial classes, such as the overmen, firemen, and others. The toast coupled with it the name of Mr. Cadman, the outgoing president.

Mr. James C. Cadman, in the course of his reply, claimed that the Institution had done excellent work for the mining industry of Great Britain. He did hope the South Wales Association would see their way to join and thus make the Institution one solid Association. He thought their transactions became more valuable every year.

The toast of "H.M. Inspectors of Mines" was proposed by Mr. H. Sopwith, and responded to by Mr. W. N. Atkinson.

Professor Louis proposed the "Belgian Association" in the following terms:—

"M. le President, M. M. les Membres de l'Institut des Ingenieurs Sortis de l'Ecole de Liége,—Notre Institut m'a fait l'honneur de me confier la tâche de vous adresser la parole et de porter un toast en votre honneur ; c'est une tâche que j'aurais hesité d'entreprendre, si je ne savais pas d'avance que j'étais assuré d'un acceuil tout à fait sympathique. Nous sommes heureux, Messieurs, de vous voir chez nous, car les ingenieurs des mines Belges et Anglais sont liés depuis longtemps par des sentiments d'amitié et d'estime mutuels. Nous vous recevons. Messieurs, non seulement comme des amis, mais comme des collaborateurs et des confrères, et je vous prie de croire à la sincerité de nos sentiments fraternals, sentiments qui ne sont pas d'hier, car je peux bien dire qu'ils ont pris leur origine primitive dans l'époche carbonifère. Votre Association et notre Institut son surtout liés étroitement par le lien commun d'une collaboration dans un des buts les plus importants que l'ingénieur de mines peut se proposer ; je parle de l'amelioration des conditions du travail souterrain et surtout au point de vue de la sureté de la vie humaine. Personne ne peut ignoré qu'ont fait les Ingenieurs Belges en matière, pour ne citer que quelques example frappants, des lampes de sureté, des explosifs et de la ventilation, and nous vous sommes très reconnaissants du temps et des talents que vous avez consacrés à leur étude.

Nos deux pays ne furent pas seulement les premiers qui ce sont serieusement occupés des developpement de l'exploitation de la houille, mais, marchant de front l'un et l'autre, nous avons frayé les chemins et tracé les routes que tous les autres mineurs de charbon ont suivi, et nous pouvons nous vanter d'avoir travaillé ensemble à perfectionner la science minière.

Dans la liste honorable des ingénieurs Belges qui ont contribué à la perfection actuelle de notre science il ne figurent pas des noms plus glorieux que ceux portés par des ingenieurs sortis de la celébré école de Liége. Donc, Messieurs, je me permets au nous des ingénieurs de mines anglais ici réunis de vous souhaiter une bienvenue très cordiale et de boire à votre santé.

M. Magery, the president of the Belgian Institute, responded, referring also to the very cordial relations which had long existed between the two societies. Next year at Liége they would be holding their annual congress, and they hoped to see many of the members of the Institution present. He could assure them they would do their utmost to give them a hearty welcome. M. Magery concluded by announcing that Sir Lowthian Bell and Mr. James Cope Cadman had been elected honorary members of his society.

The toast of "The Chairman" was also honoured, and at intervals during the evening vocal selections were given by the Ballad Singers' Quartette.

THE EXCURSIONS.

BIRMINGHAM UNIVERSITY.

Fine weather favoured the excursions and after hearing Prof. Redmayne's paper on the Mining Department of the University of Birmingham, members were naturally glad to have an opportunity of inspecting the new buildings, the experimental mine, etc.

As will be seen from the photo on page 349 taken on the same day, the new buildings have not as yet emerged from their scaffolding, and without the explanations given by the professor at every turn members would have been somewhat at a loss in the huge unfinished halls and corridors. After an inspection of the buildings and engineering departments the accompanying photos were taken showing groups of members. Late in the afternoon the Right Hon. Joseph Chamberlain (Chancellor of the University) and Mr. John Morley were observed making a tour of the buildings under the guidance of Prof. Redmayne.

THE EARL OF DUDLEY'S ROUND OAK IRON AND STEEL WORKS.

These works comprise iron works for the manufacture of high-class bar iron; chain works for the manuacture of chain; and steel works for the manufacture of Siemens-Martin steel in bars of every variety of section.

The iron works were erected some fifty years ago by the late Earl of Dudley, for the manufacture of bar iron from minerals raised on his own estates, and have continued in operation ever since. The works contain four bar or merchant mills, namely, a 16-in. mill, a 12-in. mill, an 8-in. mill, and a 7-in. mill, and a very complete forge for the manufacture of puddled iron.

The chain works commenced operation about fifteen years ago for the manufacture of high-class chain for the Government, and chains have been supplied to the British Admirallty from the commencement up to the present time. Every size of chain is produced in these works, from ⅛ in. up to 4½ in.

The steel works, commenced some nine or ten years ago, comprise five large open-hearth-steel melting furnaces, standing in a shop 350 ft. long by 90 ft. wide. A powerful electrically driven overhead travelling crane covers the whole area of the shop. This crane is fitted with two independent hoisting crabs, one capable of dealing with a load of fifty tons and the other with a load of twelve tons; it is also fitted with a controlling cage at either end, containing a complete duplicate set of controllers.

The steel melting furnaces are supplied with molten iron, brought by a locomotive direct from the blast furnaces in ladles of large capacity, and it is poured direct into the furnaces by means of an overhead crane, thus accelerating the process of steel making.

The Bertrand-Thiel process of making steel consists in partially converting the molten iron in the primary furnace, and in completing the process of conversion in the secondary furnace. By this means a very high quality of steel is produced.

A large metal mixer or storage furnace was seen in process of construction. When complete, it will hold, ready for immediate use two hundred tons of molten iron. On the charging platform in front of the Siemens' furnaces, an electrical charging machine of American design is installed for putting in automatically all cold material that is required in the process of steel making. The ingots produced in this shop are transferred by cranes, while hot, to a horizontal hydraulic charging machine, which deposits them in one of the heating furnaces (of which there are several arranged in a circle); and the same machine is used to withdraw the ingots from the furnaces, and to pass them by means of live rollers to the cogging mill. This mill, with rolls 32 in. in diameter and 8 ft. long, driven by a high-pressure reversing engine, with cylinders 42 in. in diameter by 5 ft. stroke, rolls the ingot down into a bloom of suitable shape for the finishing mill, which is placed directly in advance of the cogging mill at a distance of some 200 ft. The bloom from the cogging mill, after passing through powerful shears, which remove the ragged scrap ends, is conveyed by means of live rolls to the finishing mill, where it is rolled into the finshed bar or section. This mill has rolls varying from 28 in. to 32 in. in diameter, 7 ft. long, and is also driven by a reversing engine of similar design to the cogging mill engine. As the finished bar leaves this mill it is cut to the required lengths by means of saws, and after cooling and straightening, the bars are ready for the market.

There are numerous electrically-driven appliances in these works, such as cold saws, straightening machines, drilling and punching machines, etc.

At the conclusion of the inspection light refreshments were dispensed.

THE STAFFORDSHIRE STEEL AND INGOT IRONWORKS.

The Staffordshire Steel and Ingot Iron Works of Messrs. Alfred Hickman, Ltd., were visited by a large party, some of whom figure in the photographs shown on page 349. Situated about two and a half miles from Wolverhampton, these works, including the adjacent collieries and brick-field, cover an area of some 200 acres, and are traversed by about ten miles of railway and tram line.

The visit was rendered the more interesting owing to the fact that the firm had recently installed some additional engines driven by blast-furnace gas, and engaged in driving an electric generating plant and blowing air to the blast-furnaces. They have also erected a mixer furnace (capacity 180 tons), for treating the molten metal after leaving the blast-furnaces, and before being blown in the Bessemer converter.

The iron-ore, partly obtained from the Astrop mines in Northamptonshire, is discharged into hoppers, whence it is transferred into barrows for transport to the blast-furnaces.

There are six blast-furnaces 60 ft. in height, eleven large stoves, and five blowing-engines varying from 100 to 400 h.p. Three furnaces are making basic pig, and a similar number of kilns are employed in calcining the ore. The output of pig iron averages 2,000 tons per week, and is partly used in the steel-works. The Bessemer-process plant comprises three converters, with an out-turn capacity of 1,500 tons of steel ingots per week. The converters are supplied with blast by two powerful blowing-engines, and connected therewith are large cranes worked by hydraulic pressure. There is a complete Moore plant of ballast moulding machines, for the manufacture of ballast used in railway construction and maintenance.

There are four reheating-furnaces, a new type of the Siemens regenerating apparatus and cogging-mills, fitted with hydraulic gear, and a tilting attachment driven by an engine. The 24-in. bar mill rolls large sections in bar, up to 16 in. in flats, 8 in. in rounds, and 8 in. by 8 in. in angles. The plate rolling-mills are furnished with plant producing plates of the largest size for engineering and constructive works, some of these measuring 6 ft. in width and weighing up to 3 tons. The 15-in. bar mills, used for rolling small sections, and the 24-in. mill, are driven by an engine of 690 h.p. combined; the plate-mills by an engine of 600 h.p., cogging-mills, 560 h.p.; blowing-engine, 500 h.p.; and hot shears, 150 h.p. The steam for the engines is generated by two batteries of seventeen large boilers, 30 ft. long by 8½ ft. in diameter, partly fired by the waste-gases from the furnaces.

The works are lighted throughout by electricity, the dynamos being driven by a compound condensing engine of 350 h.p. The grinding-works reduce the basic slag to the consistency of fine-grade flour, from 85 to 90 per cent. being fine meal, passing through a sieve of 10,000 holes to the square inch.

The blast-furnaces gases are used for driving three two-cylinder tandem engines, by the Premier Gas Engine Company, each of 320 h.p. driving three generators of 150 kilowatts; a blowing-engine of 550 h.p. by Crossley Bros. with two gas and two air cylinders; a premier blowing-engine of 1,000 h.p. and a tandem blowing-engine of 800 h.p. by Richardsons, Westgarth and Co.

VISITS TO COLLIERIES.

After considerable discussion as to the probability of coal measure existing over the so-called eastern boundary fault of the South Staffordshire coalfield, a sinking was commenced at Sandwell Park Colliery some thirty years ago, and after encountering numerous difficulties the thick coal seam was struck at a depth of 1,260 ft. This discovery has been of enormous importance to the district, and indirectly led to further developments. The colliery is fitted with machinery and appliances arranged for an output of 2,000 tons a day; and at the present time a new sinking is being made to still further develop the estate.

A visit was also paid to Hamstead Colliery, situate 4½ miles north-west of Birmingham. The workings are bounded on the western side by the eastern boundary fault of the South Staffordshire coalfield, separating it from the West Bromwich coalfield, and on the east by an unproved fault. The shafts were sunk in 1880. The coal measures were reached at a depth of 768 ft., and at 1,836 ft. the top of the thick coal seam was reached. The seam is 24 ft. thick in the shafts, but it thins northward. The main roads are driven out to the boundary and the work is brought back. The system of working is that of "square work," the recognised method of working the thick coal seam throughout South Staffordshire. In November, 1898, a fire occurred in one of the main roads, and the shafts were closed. In February, 1899, new roads were driven from the shafts in the Brooch coal seam at a depth of 1,740 ft. These roads were driven about 1,500 ft., and were then inclined at an angle of 1 in 5 so as to meet the main roads in the thick coal seam. Dams were built in the road which had taken fire, and the old roads and workings were recovered. The roads were found to be completely closed. Owing to the depth and thickness of the coal seam the pressure relieves itself by "bumps," which occur, from time to time, without any warning, shaking the roof and floor and sometimes knocking out the timber.

Attention was also drawn to the Langley Boring on the Birmingham side of the eastern boundary fault of the coalfields. This is being made by the new Calyx Boring Company's specially designed deep boring installation, for the express purpose of obtaining a large core of the thick coal seam at a depth of about 1,400 ft.; a previous boring (by another system) having failed to secure any core, although it proved the existence of the seam.

EXCURSION TO STRATFORD-ON-AVON, WARWICK, AND LEAMINGTON.

Ladies were specially invited to participate in this excursion to Shakespeare-land, including the beautiful drive through one of the most beautiful parts of Warwickshire to Warwick Castle.

Professor Redmayne advises us that since the meeting in Birmingham, he has received word from the Government of India that four scholarships have been established of £150 per annum each, *plus* travelling expenses and fees, to encourage technical knowledge, and especially knowledge connected with the mining industry in Bengal. The scholarships are tenable for two years (with possible extension to three years) in Europe or America by natives of India, and it has been arranged that those to whom the scholarships have just been awarded shall join the University of Birmingham to undergo a course of training in the management of mines, from the beginning of the session commencing the first week of October.

PAGE'S MAGAZINE

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OUR MONTHLY SUMMARY.

LONDON, September 28th, 1904.

A Notable Tramway Development at Huddersfield.

An interesting tramway development during the last month was the inauguration at Huddersfield of a motor coal-wagon system for the carriage of coal over the Corporation tramways. At present a single wagon, designed by Mr. H. N. Thomas, has been put on the metals, and is used for the conveyance of coal over the distance of four miles separating the railway sidings and a mill at Windley, belonging to Messrs. Martin, Sons and Co., Ltd., with whom the Tramways Committee has entered into a special contract. The wagon, which has been constructed by Messrs. Milnes, Voss and Co., of Birkenhead, is mounted on a Brush radial truck, equipped with Westinghouse motors. The trial trip proved most successful. The wagon, which carried about ten tons of coal, negotiated the difficult gradients and curves without a hitch of any kind, and we understand that arrangements are being made for the construction of a second wagon. The slack hours of the morning are to be used for the coal-conveying operations, and we imagine that they will be watched with the greatest interest by electrical concerns in search of increased dividends. The progress of a heavy looking coal wagon with trolley along the electric tramway is a somewhat novel but very suggestive sight, and we shall be surprised if the system does not make very rapid development.

The Production of Coal.

Since our last issue, attention has been called to the world's coal production and consumption by the tenth annual general report on this subject by the Board of Trade. The production of coal in the five principal coal-producing countries of the world during the last three years is given as follows :—

	1901. Tons.	1902. Tons.	1903. Tons.
United King.	219,047,000*	227,095,000*	230,334,000*
Germany ..	108,539,000†	107,474,000†	116,638,000‡
France	31,634,000†	29,365,000†	34,318,000‡
Belgium	22,213,000†	22,877,000†	23,912,000‡
United States	261,874,000*	269,277,000*	320,983,000*

* Tons of 2,240 lb. † Metric tons of 2,204 lb.
‡ Provisional figures.

The production of coal in 1903 in each of these five countries was greater than in any previous year. The production of the United States exceeds that of the United Kingdom, but the production of Germany represents only about a half, and that of France and Belgium together about a quarter of the production of this country.

The total known coal production of the world (exclusive of brown coal or lignite), is now about 790 million tons (of 2,240 lb.) per annum, of which the

United Kingdom produces rather less and the United States rather more than a third.

As compared with its population, the production of coal in the United Kingdom still surpasses that in the United States. It amounts to nearly 5½ tons per head; whilst in the United States it is still slightly less than 4 tons per head. In Belgium it amounts to about 3½ tons per head, in Germany to about 2 tons per head, and in France to under a ton per head.

Prices of Coal.

The following statement shows the average value per ton of the coal produced taken at the collieries, in the five above-mentioned countries, in the year 1902:—

	Per ton. s.	Per ton. d.
United Kingdom	8	2¾
Germany	8	10¼
France	11	8¾
Belgium	10	6¼
United States	5	8¼

These prices represent a fall of about 1s. 2d. per ton in the United Kingdom, of 6d. per ton in Germany, 11d. per ton in France, and 1s. 8d. per ton in Belgium, but a rise of 2d. per ton in the United States.

The provisional figures available for 1903 indicate a further fall of 7d. per ton in the United Kingdom and 3d. per ton in Germany, whilst in the United States there has been a further rise of 10d. per ton.

Production in the Colonies.

The following statement shows what was the production of coal in the principal British colonies and possessions in the year 1902—

	Tons.
British India	7,424,000
Australian Commonwealth	6,860,000
New Zealand	1,363,000
Canada	6,422,000
Transvaal	1,420,000
Cape of Good Hope ..	166,000
Natal	593,000

Preliminary figures are available for the output of Canada, New South Wales, Natal, and the Transvaal in 1903, which was in each case the greatest recorded, the figures being as follows:—Canada, 7,140,000 tons; New South Wales, 6,355,000 tons; Transvaal, 2,016,000 tons; Natal, 714,000 tons.

Where Our Coal Goes.

The following statement gives particulars of the excess of exports over imports in 1902 in the countries and British possessions named:—

	Imports. Tons.	Exports. Tons.	Excess of exports. Tons.
United Kingdom	3,000	60,400,000	60,397,000
Germany ..	6,870,000	18,891,000	12,111,000
United States ..	2,544,000	6,127,000	3,583,000
New South Wales	*	3,261,000	3,261,000
Belgium	3,496,000	6,574,000	3,078,000
Japan	73,000	2,939,000	2,866,000
Transvaal ..	*	291,000	291,000
Natal	—	240,000	240,000
British India ..	229,000	432,000	203,000
New Zealand ..	128,000	192,000	64,000

* Less than 1,000 tons.

The principal coal-producing countries which imported coal in excess of the amount they exported in 1902 were Russia, Sweden, France, Spain, Italy, and Austria-Hungary, whilst the principal British colonies and possessions that did so were Canada, the Australian States (except New South Wales) and the Cape of Good Hope. The other British colonies are nearly all importing countries.

Are We Throwing Away a National Asset?

While on the subject of our coal exports, we may place on record our conviction that Professor Boyd Dawkins' arguments as to the unwisdom of allowing the free export of steam coal have been pretty conclusively answered.

The Professor, in a recent letter in the daily press, remarks that the South Welsh smokeless steam coal does not occupy more than one-fifth of the area of the whole coalfield, and, according to the Director of Naval Contracts, out of the many collieries in South Wales, there are only twenty-four on the Admiralty list for the supply of the British Fleet. It occurs nowhere else in Europe, and the only other source of supply used by the Admiralty, and that altogether insignificant, is New Zealand. We have, therefore, a monopoly in Europe of one of the most valuable elements in naval warfare, related to other coals as smokeless to black gunpowder. It also yields more power, bulk for bulk, than any other coal. In other words, it is a national asset which, dealt with on common-sense lines, would go far to give us the mastery of the sea.

At first sight, this view of the case is very plausible, and if the exhaustion of these coal fields were threatened within, say, the next decade, there would be some ground for restrictive measures. When, however, one learns on the authority of Mr. Macaulay, General Manager of the Alexandra Docks and Railway at Newport, that the supply of Welsh steam coal will probably last for a hundred years at least, the matter assumes a different complexion. It is not given to everyone to look far ahead. One writer tells us that even Nelson so far believed in the endurance of the "wooden walls" of his time, that he advocated the special planting of oaks in this country in order that the native supply of the best material for warships should never fail. As Mr. Macaulay aptly says, "Who can imagine for a moment that such a crude form of generating power as the direct burning of coal in a furnace will obtain a hundred years hence? Instead, possibly having passed through an intermediate stage of oil fuel, a practicable method of cheaply storing electrical power may have been discovered, and the picture of the "Coaling of a Battleship in 1904" will be found hanging as an interesting curiosity upon the cabin wall of the commander of the period, much as we hang pictures of stage coaches upon the walls of our drawing-rooms. The battleship of 1954, or 2004—if she will have herself survived—will moor alongside the power station at the naval base, connect a few wire ends with those upon the quay, and have her accumulators charged in a few hours for three months' continuous steaming, the power being cheaply generated by 'producer gas' engines, by tidal rise and fall, or by the harnessing of some other natural force."

The Board of Trade Regulation of Electrical Energy.

The new Board of Trade regulations governing the supply of electrical energy show a very satisfactory tendency to greater liberality, and, as such, should be welcomed by the entire industry. Four pressure standards have been fixed for both alternating and continuous currents, viz.: Low-pressure, up to 250 volts; medium-pressure, from 250 to 650 volts; high-pressure, from 650 to 3,000 volts; and extra high-pressure, exceeding 3,000 volts. It will no longer be necessary to obtain the special permission of the Board in order to supply consumers with current at any pressure greater than 250 volts; in fact, subject to certain reasonable precautions, the customer may be supplied for such purposes as motor driving or series arc or incandescent lighting at any pressure up to 650 volts. The introduction of medium-pressures into consumers' premises for other purposes, or of high-pressures must, however, be specially sanctioned. Extra high-pressures may be supplied to factories, mines, and traction works, subject to the consent of the Board and the provisions of the Factory Acts and Mines Regulation Acts, and the new regulations provide for elasticity of intrepretation by the Board under special circumstances.

The Regulation of Wireless Telegraphy.

The necessity for Government regulation of wireless telegraphy can scarcely be questioned even by those who are chiefly engaged in this form of electrical development. Strategic considerations render it imperative that in time of war or emergency the Government should exercise control and supervision over all means by which information could be conveyed to an enemy, and of preserving such secrecy as to plans and preparations as is essential for successful operations. It must not be forgotten (in London no one is likely to forget it) that in this country aliens abound, while there is, of course, nothing to prevent any individual setting up a temporary "wireless" installation on his own property. That bugbear of wireless telegraphy interference as between neighbouring stations can only be met by Government regulations and by the careful selection of sites.

The Government will place on a firmer footing the maintenance of wireless communication between the ships of the navy. At the same time, the question, though in our view ripe for legislation, presents many difficulties, the most prominent being the danger of paralysing individual effort and putting a brake upon invention. Again, it places large powers in the hands of the Postmaster-General, and the efficiency of the Act will depend largely upon the interpretation of those powers. The Government has, however, included two excellent safeguards in the Bill; one of these limits the operation of the Act to two years, at the expiration of which time some kind of international understanding may have been arrived at, paving the way for permanent legislation. "Companies or persons requiring license of any wireless telegraph station" have been officially advised to make application to the Postmaster General before October 1st, 1904.

Another point covered by the Bill is based upon the determination of the Government that in this transitive period vested rights shall not be allowed to grow up which the State hereafter may have to purchase at an immense cost. The granting of licenses cannot prevent the survival of the fittest system, and the consequent creation of that monopoly which the successful inventor regards as a legitimate haven. But it is easy to see that, should the question of State purchase arise, the task of the Government would be greatly simplified. In passing a Bill for the regulation of Wireless Telegraphy, the Government has only followed a course which other countries have already adopted. It is none the less to be regretted that more time could not be found for the discussion of the measure in Parliament.

The Ideal Foreman.

Mr. Frederick W. Turner has been setting down in the "Technical World" his conception of the ideal foreman, though he concludes that that functionary, however anxiously awaited and badly needed, has yet to be discovered. In the meantime, it may not be unprofitable to consider some of the desiderata which Mr. Turner lays down for his ideal. Before all other qualifications, it is necessary that the foreman should be what the word implies—first, a man; and, second, a leader. If he is a man in the true sense of the word, he cannot fail to be respected by all self-respecting workmen. If he is an honest leader, he will conduct those workmen along the lines laid down by the owners as the policy of the establishment. Toward the firm the foreman should be respectful, obedient, and energetic; toward the workmen he should be firm, just, and sympathetic.

Of all the qualities going to make the ideal foreman, that of tact is the most important. It means that the men will be treated as individuals, their failings noted and corrected, their good points enlarged upon, and due credit allowed for them, and that the shop life will be freer and more natural. With this tact, or faculty of governing along the line of least resistance, must be coupled absolute fairness. A decided, but not aggressive manner of passing opinions upon questions serves to inspire the men with respect for the foreman, especially if such decisions are rendered promptly, and they prove, in the large majority of cases, to be accurate.

Fairness, dignity, and firmness are qualities that can be quite closely defined; but tact, and its fellow-attribute, executive ability, are rather elusive of close description. They are of the inherited type, and can be cultivated only to a very limited extent. If a man does not possess tact and executive ability, it is useless for him to accept a position where they are essential, in the belief that they will develop as required.

Should be Promoted from the Ranks?

Another question, which has more than one answer, is whether it is better to have a foreman promoted from the ranks or to get an outside man for the position. The man from the bench is familiar with all the shop traditions and practices, and can keep things going with hardly a break. On the other hand, he is the victim of jealousy and spite, and, unless exceptionally well-poised is apt to assume an attitude towards his former shopmates which might be termed "dignity gone to seed." Every youthful indiscretion is remembered, and any attempt to check such artics on the part of the younger men is held to be an unwarranted assumption of dignity. On the whole, the attempt to promote a foreman from the floor or bench is fraught with difficulties; and many a man who would have made an excellent foreman in another shop, has been a rank failure in that capacity when tried among his old shop associates. The foreman taken from the outside stands or falls, as far as the workmen are concerned, on his record in his new position. He is not condemned for past faults. Furthermore, he should be able to bring into his new associations some of his experience in former situations, which will be of value to his new employers. It is an infusion of new blood, which is often the means of discovering leaks and weaknesses not noticeable to the old employees.

A foreman's value to a firm depends largely on his knowledge of the capacity and limitations of each man under him. This knowledge enables him to lay out his work to the best advantage, as he knows the man who is quick, the man who is accurate, and the man who can be trusted to carry along detail or experimental work. To keep a man up to his best pace, to have new work laid out for him in advance, and to keep that man satisfied with his work and wages, is a task that taxes the ingenuity of the best of foremen.

Protection against Torpedoes.

A propos of the article which appeared in the last issue of PAGE'S MAGAZINE on "The Protection of Battleships below the Water-line," we quote the following interesting remarks by Sir William White in the "Naval Annual": "There have been many proposals to extend the use of armour plating to the submerged portions of ships, more especially as a protection against torpedoes. Experiments have shown that, if fitted on the outer bottom, armour is ineffective against the explosion of large charges of explosives in contact with, or very near to, the ships. As a result, it has been suggested to fit armoured inner bottoms (or wing bulkheads) at a few feet inside the outer skins, which were to be formed as usual of thin steel plating. Sir Edward Reed has patented arrangements of this nature, and Russian designers are reported to have constructed armoured 'wing' bulkheads in their latest battleships. The *Borodino* class are said to have vertical and longitudinal armour bulkheads 4 in. thick in wake of engines and boilers, extending from the armoured deck down to the turn of the bilge (about 23 ft. below water), and placed about 5 ft. to 6 ft. from the outer skin, and 4 in. armour on the outer bottom. The latter item seems doubtful. In the *Cesarevitch*, it is stated that there are armoured wing bulkheads, but ordinary outer skins. As yet our information is incomplete, but so far as is known the armour protection to the under-water portions of the *Cesarevitch* have been altogether ineffective, and she has been put out of action as completely as her companion ship, the *Retvisan*, which was constructed in the ordinary manner. Personally, I have been always opposed to this application of under-water armour, chiefly because it appeared probable that, even with external armour fitted at some distance from the outer bottom, the effect of the explosion of a modern torpedo would produce such serious shocks and jars upon the armoured inner bottom or bulkhead and its fastenings, that leakage into the interior would result even if the armour itself was not perforated or driven in. So far as can be judged from accounts hitherto available, this form of injury really proved fatal to the *Cesarevitch*, for it would seem that she was kept afloat for a considerable time by her pumps, and this suggests that the leakage which occurred was through openings having a small aggregate area such as would result from 'jarring' of the rivets and fastenings, rather than from any large hole in the water-tight portions of the structure, through which water would pour in large quantities and overpower the pumps.

Torpedo *v.* Gun.

"Another serious danger from the use of external armour, supposing that this material did its work and maintained its integrity, obviously arises from the 'water-logging' of spaces outside the armour protection, but within the ship; which water-logging would inevitably result in serious heeling or possibly in absolute instability. Calculations made for typical vessels protected in the manner suggested have shown conclusively that this danger from water-logging is real and great. On the whole, therefore, my opinion remains unchanged, and, in my judgment, the use of under-water armour as a protection against torpedoes is not to be recommended. Torpedo attacks have no doubt been greatly developed in recent years, by improvements in the speed and increase in the charges of locomotive torpedoes, and it may be anticipated that the school of writers who take exception to the construction of large and costly battleships or armoured cruisers will be disposed to point to recent events at Port Arthur as additional proofs of the soundness of their contention that it is unwise to 'put too many eggs into one basket.' My own conviction is that these improvements in torpedoes are matched by the advances made in rapidity, range, and accuracy in gun-fire, and in projectiles and 'bursters.' So that relatively the gun and the torpedo stand much in the same relation as before In these and in all questions of warship design it is necessary to take a broad and comprehensive view not to narrow the discussion to a single feature of offence or defence."

The Functions of the Electric Furnace.

An author once said that "the function of an electric furnace is to produce a temperature of a degree or in a place unattainable by other means." Mr. Bertram Blount, F.I.C., in his third lecture before the Society of Arts, on "Recent Advances in Electrochemistry," described in an interesting manner the functions of the electric furnace. He remarked that the above rather bald quotation is defensible on the ground that it indicates concisely the two chief services which an electric furnace alone can render. Mr. Blount showed that when a moderate temperature is needed, and where the heat can pass directly in company with products of combustion, there is no particular advantage in employing the electrical method; its use can only be remunerative in a place where fuel is extravagantly dear, and some other source of power unusually cheap, for it must be remembered that when heating is effected by electricity prepared from fuel through the agency of a steam engine or gas engine, not more than 15 per cent. of the heat energy of the fuel will be obtained in the electric furnace supplied therefrom. The high cost of electrical heating is in certain cases more than balanced by the two advantages stated in the definition of the function of an electric furnace; these are, in the first place, the capability of an electric furnace to produce a temperature greatly higher than the highest which can be obtained by the direct combustion of fuel, and, secondly, the possibility by its means of heating a chamber internally without transmitting heat from the outside through the walls of that chamber.

Some Products.

Without seeking to draw a hard and fast line between these two uses, the author gave an example of each type. Carborundum, he remarked, is purely a creature of the electric furnace; no other means is known by which a temperature high enough for its formation can be obtained; calcium carbide, made by the direct action of CaO on C, is in the same category. The preparation of phosphorus is an instance of the other kind; this element can be, and has been, prepared for many years without the use of the electric furnace, and the present predominance of electrical heating is due to the fact that the transmission of heat to a charge which must be enclosed in a gas-tight vessel can be effected more economically with moderately dear heat applied internally than with cheap heat, which must pass through the walls of a fireclay retort.

There are two chief types of electric furnace. In the one heat is generated in an arc; in the other there is a continuous core which serves as a resistance. The two types are not completely distinct, because if the core is not perfectly continuous the course of the current will be marked by the occurrence of numerous small arcs. In practice the pure or "toasting" arc (to borrow an epithet due to Mr. Swinburne) is never used. The heat is too valuable, and the arc, though it will still exist in detail, is smothered as far as may be.

The efficiency of the electric furnace is fairly high. Richards has calculated that according to the nature of the operation the efficiency will range from 38 to 76·5 per cent., a result relatively good when the high temperature reached is considered.

Sweeping Condemnation of the Premium System.

As we go to press the following resolution on the Premium System has come to hand, passed by the specially appointed committee of the Engineering and Shipbuilding Trades Federation: "The question has had the earnest consideration of a sub-committee of the executive council and of the annual meeting of the Federation, and they are unanimous in condemning any system of payment of wages except by the hour, or in cases where it is recognised by mutual arrangement between the workmen and their representatives and the employer, by piecework; and they strongly recommend the societies represented on the Federation to do all in their power to prevent their members working under any premium bonus system, as they are convinced that the general adoption of any such system will be disastrous not only to the interests of the workmen concerned, but to the reputation of sound and honest workmanship, which, we trust, will be pre-eminently the characteristic of British manufactures throughout the world. The system has absolutely nothing to recommend it; it is an adaptation of the most pernicious and degrading condition of employment in modern industrial history—the task-work system; it creates jealousy and ill-feeling in the workshop, and is the cause of endless bickering and misunderstanding owing to the complicated and intricate character of the calculations involved in many systems; it has been the cause of more men being discharged than any strike which has ever taken place in the history of the engineering or shipbuilding trades; and it will have the effect of keeping men, whose waning physical powers unfit them for the closest and hardest labour, from obtaining employment except when trade is at its busiest."

AMERICAN RÉSUMÉ.

By Our New York Correspondent.

NEW YORK, September 12th, 1904.

An Advance in Electrical Railroad Work.

The American technical press has devoted considerable space to the General Electric Company's new compensated motor for railway service. The trial of the new motor took place on the Ballston division of the Schenectady Railway.

This line has a double track of 75 lb. rails laid with 13 ft. centres on a private right of way 60 ft. wide. The overhead construction is arranged to carry both direct and alternating current trolleys. Centre pole bracket construction is employed, and two iron brackets support two 600-volt direct-current trolleys over the centre of the track in the usual way. A wooden cross arm below the brackets supports the alternating current trolleys in a new and original manner. The cross arms carry standard porcelain insulators, between which are strung ⅜-in. steel wires and to these wires, midway between their points of support, are clipped the alternating current trolleys which carry a pressure of 2,200 volts.

The "Railway and Engineering Review" remarks that the advent of an electric motor, using single-phase alternating current, which will operate successfully under the difficult requirements of heavy and high-speed traffic, marks a distinct advance in the progress of electric railroad work in this country. Here the polyphase current has found but little favour, principally because it introduces too large a number of complicated and expensive parts. All efforts here have been for the use of single-phase current, which is comparatively simple, both of transmission and utilisation as well as control. The main obstacle has been that the single-phase machine refused to start under load. This has now been overcome.

The new motor is the result of a long series of exhaustive experiments and studies on the part of engineers responsible for its production, and apparently solves the problem. It uses single-phase alternating current with a pressure at the brushes and controller which is easily handled, while at the same time a high trolley voltage, requiring a small amount of copper and infrequent sub-stations, is used. It will start under a heavy load and exert a torque corresponding to the load, which is the primary requirement of a railroad motor. The ordinary method of control by changing connections from series to parallel and cutting out resistance can be used in the same manner as for a direct-current motor. In fact its operation is almost exactly the same as with the present standard type of direct-current street car motors, the only noticeable difference being in the matter of acceleration, and that is slight. It has a still further advantage of running with direct current as well as with alternating. In appearance it looks exactly the same as a direct-current motor having a segmental commutator, standard brushes, and the same mechanical construction throughout. The whole difference lies in the manner of winding the coils, particularly in the fields, which have some extra or compensating coils arranged in such a way as to neutralise or compensate the armature reaction.

Bridge Building in U.S.A.

In the course of an address on "Progress in Railroad Bridge Building," delivered by Mr. F. C. M'Math, at the annual meeting of the Detroit Engineering Society, it is remarked that probably nowhere in the world has the art of bridge building progressed faster than in the United States. Previous to 1860 practically all of our truss bridges were of timber construction—mainly of the Howe truss type. About this date the building of spans with cast-iron compression members and wrought-iron tension members became the fashion, and a few metal bridge building establishments sprang up; each concern usually adhering to some particular type of construction, such as the Fink truss or Bollman truss.

About 1880, bridges constructed entirely of wrought iron began to be commonly used. Seven or eight years later, steel eyebars were substituted for wrought iron tension members, and about 1890 the iron compression members had to give way to those of steel.

The change from iron to steel was opposed by many engineers, but steel won the day on account of its lower cost.

During the period of change in the materials of bridging, a very great change took place in the weight of rolling stock. In 1860 an ordinary locomotive and tender would weigh about 40 tons; in 1880 a 66-ton engine was thought a monster. In 1890 engines of 100 tons were believed to be about the limit, but now there are plenty of engines weighing, with tender, 140 to 150 tons. These radical increases in loads naturally had a marked effect on the bridge building industry. A bridge built for the loads of 1860 needed renewal about 1880, and structures designed for 1880 conditions had to come out before 1890.

Pin v. Riveted Spans.

Pin-connected spans have been the favourite type in the United States from the earliest days of metal bridge building. Some years ago quite a controversy arose between American and English engineers as to the relative merits of pin and riveted spans, the latter being the distinctly English type. American engineers apparently had the best of the argument, the pin structures being unquestionably lighter in weight and cheaper to erect. In recent years, however, a strong tendency has set in toward the use of riveted structures for spans of short or moderate length. Most bridge engineers would not now use pin designs for spans less than 125 ft.; and a few railroads, such as the New York Central Railroad, have practically cut out pin bridges altogether and are now making the riveted bridge their standard type. In Canada the riveted bridge has been in favour for some time by the leading railroad companies, being used quite generally for all spans up to 200 ft., whether single or double track. Mr. M'Math goes on to say that there can now be no question but that the English engineers were pretty much in the right in their old contention in favour of riveted bridges—at least for spans less than 200 ft., which cover the bulk of ordinary railroad structures. American engineers, however, have by no means copied English designs, even if they are coming around to the English type.

American designs use longer panels and much deeper trusses, and on this account our structures are lighter, stiffer, better, and cheaper than the English. For some occult reason the English engineer feels that the slope of his diagonal truss members must be exactly 45 degrees, if possible, and that the depth of truss must not exceed one-eighth the span length.

His adherence to these thumb rules makes his designs heavy and expensive, and, for short spans, often defective in their top chord bracing. They use difficult details, apparently taken from their shipbuilding practice, where probably there are good reasons for their use, for it must be admitted that they are masters of the art of shipbuilding.

Manhattan Bridge.

The delay in constructing Manhattan Bridge, New York, is in many quarters producing a feeling akin to desperation. Six years have passed, says a contemporary, and still, all that the city can show in actual work completed is the foundations on the shores of the East River. Those who know something of the leisurely delivery of the wire cable used in the construction of the Williamsburg Bridge, place the date of completion of the Manhattan Bridge at 1909. Crowds still struggle for a chance to ride home across the old Brooklyn Bridge every night. Where is this hopelessly unbusinesslike and impractical method of constructing the engineering works of a large city to bring us? How long will it take to build the Manhattan Bridge, if each new Commissioner is to discard his predecessor's plans and substitute others for them? If it has taken six years to build the tower foundations, how long will it take to build a whole bridge?

Mineral Output in the United States.

The production of the principal metals in the United States from 1840 to 1902, inclusive, is shown in the accompanying diagram, constructed by Mr. F. L. Ransome, from the reports on Mineral Resources issued by the United States Geological Survey and from the report of the Director of the Mint. Iron is given in tons of 2,000 pounds, copper, lead and spelter in hundredweights, silver in tens of ounces and gold in ounces. The iron ores may be classified as hematite, limonite, magnetite and siderite or spathic ore. Approximately 86 per cent. of the iron ore mined in the United States is hematite, and of this upward of 88 per cent., or over 75 per cent. of the whole, comes from the Lake Plains north and south of Lake Superior.

For this interesting diagram I am indebted to the "Mining Magazine," a promising monthly which, under a new form and title, is now being published in New York. Incorporated with it is the "Pacific Coast Miner."

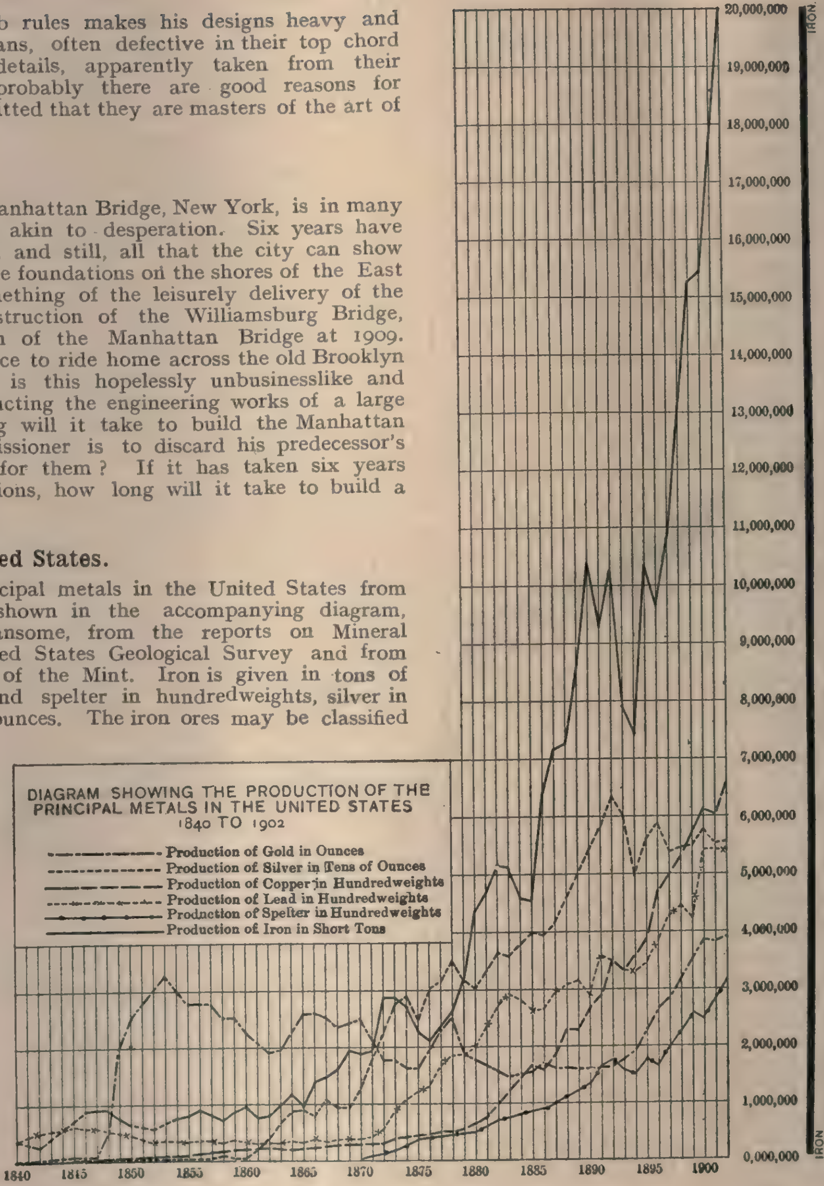


DIAGRAM SHOWING THE PRODUCTION OF THE PRINCIPAL METALS IN THE UNITED STATES 1840 TO 1902

The Distribution of Metalliferous Ores in America.

The most obvious fact springing from the author's brief *résumé* of the distribution of the metalliferous ores in the United States, is the pre-eminence in iron ores of the provinces east of the Mississippi river, and the equally striking dominance of the precious metals in the West. It is remarked that the association of the principal ore deposits with the essentially mountainous provinces is also striking, and is rendered the more so when we remember that the ores of the Lake plains, Piedmont plateau and Columbia plateau occur in rocks possessing the geological structure of mountains, although the topographic expression of this structure has been erased by long erosion or partially buried under floods of lava. Another salient fact is the practical limitation of silver ores to the physiographic provinces lying between the Pacific Mountains and the Great Plains, the contrast between the ores of this great region and those of the western slope of the Sierra Nevada being in many respects a remarkable one.

GERMAN RÉSUMÉ.

Protection against Risk on the Berlin Overhead and Underground Railway.

In the course of a comparison between the Paris Metropolitan Railway and the Berlin Overhead and Underground Railway, some interesting facts were brought out in a recent number of the "Zeitung des Vereins." The comparison showed that the risks on the Berlin Overhead and Underground Railway are considerably smaller than those on the Paris Metropolitan. At Berlin, even if the lighting of an underground station were to fail, the exits would always be visible, as they are not covered in. Moreover, the rolling stock is better protected against risk of fire. The careful examinations made by the controlling board have satisfied it that with the existing arrangements such accidents as the one referred to above could not occur. In order, however, to ensure still greater safety, the management was requested to carry out the following precautionary measures :—

1. The lighting of the tunnels is to be supplemented by connecting up the existing reserve lamps, and in the future it will be effected by two independent circuits, so that if one is damaged half the lamps still remain alight. The new circuit is to be carefully protected against damage by appropriate means (casing with metal strip or laying in iron pipes).

2. The closed ticket collectors' boxes at the platforms are to be arranged so that by pulling back two bolts they can then be easily swung out of the way, so as to make the exit wider.

3. More hydrants are to be put in ; the new ones are to be placed at points determined by the fire brigade department of the royal police. More sand boxes are to be placed at the stations ; then also each car is to have a sand box. Moreover, all cars are to be supplied with a small portable hydrant ; the same appliances are also to be placed in the tunnels, at every 100 metres (109 yards), on special pillars.

4. Each underground station is to be connected up directly with the alarm circuit of the corresponding fire station.

5. The window curtains are to be made of wool, treated with some anti-flammable liquid.

6. The second catch which secures the doors is to be done away with, so that in case of danger these catches may not cause delay in leaving the carriages.

7. Each motorman's cab is to be fitted with a short circuiting switch which can be operated either by the motorman or by the conductor by simply turning a handle inside the car. (The object of this short circuit is to cut off the supply of current from the conducting rails of both tracks, while not affecting the lighting circuits.) Moreover, each cab is to contain a portable short circuit apparatus and a torch signal.

A Proposed Visit to Germany.

The "Centralblatt der Walzwerke" refers to a report which recently appeared in an English paper to the effect that about 200 English business men intended to visit Berlin in April, 1905, in order to pave the way for a better commercial understanding between the two countries. It is stated that the idea of the visit emanated from a private source and not from the Government of either country, though the proposal is regarded with favour in German Government circles.

Proposed Ship Canal from the Rhine to the Danube.

Dr. F. Rose in a Foreign Office report gives particulars of a project, now under consideration, for the connection of the Rhine and the Danube by a ship canal by way of the Neckar. The unfavourable position at present occupied by the Kingdom of Würtemberg as regards communication with other parts is an argument in favour of the project, which, if carried out, would place Würtemberg in the middle of the largest and most important waterway in Europe. From Mannheim to Heilbronn and from Heilbronn to Cannstatt, or Esslingen, the bed of the Neckar would be utilised, and from Neckarems to the Danube the beds of the Rems, the Kocher and the Brenz. The total estimated cost is £7,000,000, of which some £2,000,000 would go to the canalisation of the Neckar. It is thought, however, that an asset value of about £1,300,000, due to the water-power from the various locks, might be expected. The length from Mannheim to Neckarems would be 110 miles, and thence to the Danube 71½ miles, or a total of 181½ miles. Other parts of Europe, besides Würtemberg, would be likely to benefit by the canal. Bavaria would gain access to the Upper Rhine, as well as to the existing French and Alsace-Lorraine canal system on the one side, and to Russia, Austria, Hungary, and the Balkan peninsula on the other. The whole of South Germany would also be brought into closer touch with East Switzerland and with Italy.

Essen and Sheffield Compared

In the current number of "Machinery" there is an interesting account of the Essen and Krupp works. The writer remarks that the English town which most naturally suggests itself for comparison with Essen is Sheffield ; and there are many points of resemblance between them. Both lie on the same hilly sort of ground that goes with the presence of coal ; both have narrow, old-fashioned, irregular streets ; both have charming country on their outskirts, though in this the advantage lies with Sheffield ; and both manufacture the same things on the same scale. On the other hand, Sheffield is more than twice as big, it is a much older manufacturing place, and has a greater variety of manufacturers. The ancient cutlery industry, file cutting, and electroplating give it a special character which is lacking to Essen. Take them as they stand, however, for what the comparison may be worth, it must be admitted that the German has rather the best of it. The site of the Krupp works on the lower side of Essen, in and out of the town, is curiously like that of the great Sheffield works—at Cammell's, Brown's, Firth's, and Vickers and Maxim's—which lie all together in a similar position, and probably occupy even more ground between them. They certainly make more smoke or it hangs more persistently about. Sheffield is the grimiest of all our manufacturing towns, with the possible exception of Gateshead, and a large part of it is generally wrapped in a pall which neither London nor Manchester can equal. America alone, with her genius for surpassing everything, easily beats it. Compared with the inferno of Pittsburg and the lesser but still more grimy and squalid hells up the Monongahela Valley—Homestead, Braddock, and the rest—Sheffield is clean and Essen a pleasure resort, in spite of the fifty or sixty tall Krupp chimneys that flank it on one side and various other factories, with sundry coalpits, on the other.

SOUTH AFRICAN RÉSUMÉ.

African Railway Developments.

The "dark continent" is no longer a term which may be fitly applied to Africa, and in the "New York Times," recently, Mr. C. C. Adams showed the vastly important part which railway construction has played in letting in the light. Five years ago, he says, there were less than 9,000 miles of completed railroad in Africa. To-day there are over 13,000 miles. Very little of this railroad development in the past few years has been in the civilised lands like Algeria and Tunis, Egypt, Cape Colony, and Natal, which are fairly well supplied, but the tracks have been extending through the jungles, forests, and deserts of the tropical colonies. In 1899 the length of these colonial railroads was only 1,226 miles; to-day there are 4,475 miles of colonial railroads in operation, and thousands of native labourers are at work on over 1,700 miles, which will probably be added to the completed mileage within another year. The prospects are that within the next six years there will be 25,000 miles of railroads in Africa.

The Cape to Cairo Railway.

As to this railway, no one knows exactly what route may be taken. It was at first intended, for example, to construct the line due north-north-east from Buluwayo to the foot of Lake Tanganyika. Then came the discovery of the Wankie coal fields, near the Victoria Falls on the Zambesi, and the routes was accordingly deflected to the north-west to take in the coal region and the Falls, and it has now been completed to this great show-place of Africa. Further than this we only know that after the bridge now building across the Zambesi is completed the line will be extended, as rapidly as possible, to the mining region of Broken Hill in Northern Rhodesia; and the latest map of the British South Africa Company indicates that the line will run from Broken Hill straight to Tanganyika.

With the completion of the line to Broken Hill, fully one-seventh of the Cape to Cairo railroad will be in operation, and there will be an unbroken stretch of rails extending from the south end of Africa nearly 2,000 miles northward. To-day the trains are running from Cape Town, 1,644 miles, to the great falls of the Zambesi that Livingstone discovered. Here the British Association will hold its meetings next year, the first great scientific body to meet in the heart of Africa. This year tourists are being carried on a Nile steamboat from the southern terminus of the Nile railroad at Khartoum to Gondokoro. By utilising the waterways on which steamboats are afloat, one may now travel by steam three-fourths of the way between Cape Town and Cairo.

Professor Hele-Shaw on Railway Developments.

The great possibilities before the engineer in improving locomotion and means of inter-communication in South Africa were ably touched upon by Professor Hele-Shaw at the fourth annual dinner of the Mechanical Engineers' Association of the Witwatersrand. The professor, having remarked that the engineer in this part of the world has as yet no need to despair of any lack of fresh fields and pastures new, continued: "Situated as you are here in the midst of a vast territory, accessibility to other parts of the world by rapid means of inter-communication will be one great determining factor of progress.

"Has the railway system, then, reached the limit of its possibilities? I do not refer to that aspect of the railway system which is exciting so much interest in councils and in the press, that is to say, economical questions and the development of fresh routes. I allude particularly to mechanical improvements which may be possible. You will have noticed the gradual growth in weight of locomotives necessary to deal with the increased units of traffic as represented by separate trains, and in a sense these gigantic locomotives are triumphs of engineering skill. But the carrying of these locomotives, amounting in many cases to, separately, more than 100 tons, is in itself the transit of a huge non-paying load. I daresay you have noticed, simultaneously with this development, the tendency towards the electrification of railways, by which, at any rate, the non-paying load of fuel, water, and the boiler itself is at once swept away. This electrification of railroads is proceeding more rapidly than most people are aware, and is certainly based on the soundest of principles, by which the stores for generating power are themselves stationary and at long distances apart, and are not carried, as in the steam locomotive, on the motor itself. To go further, instead of trusting to the increased weight of the locomotive to obtain tractive effort, each separate unit, as in the Liverpool Overhead Railway, is made to drive upon the wheels, so that every wheel in the train becomes a tractive agency. The saving in wear upon the rails by this means must be enormous. Another striking advantage is that smaller units can be employed, and instead of a few trains occupying the whole track, a continuous succession of self-propelled vehicles, properly protected, of course, by the block system, can be despatched, distributing and bringing into action the whole system with a service much more convenient and rapid. I say more rapid because unquestionably electricity promotes speeds upon railways far in excess of any obtained by steam locomotion. Witness those remarkable experiments recently made at Berlin in which a speed of 130 miles an hour was safely attained by electricity. I think, and I do not say it without reflection, that there must be room for improvement on an average speed of about 20 miles an hour, at which our fastest mail trains transport us to and from the Cape."

A Coming Type of Self-Propelled Wagon.

"Coming now to locomotion on roads, or, best, the veldt itself. I have previously expressed my view that the wheel is only perfect when we have a track hard and smooth, qualities which cannot, I think, be claimed, let us say, for the road to the East Rand. One wheel reaches, under such circumstances, the mechanical limit of its profitable carrying powers at something over two tons. Here, again, it is possible, by combining the mechanical action of the wheel of a vehicle with the use of the ankle joint, universally provided by nature for animals, to increase the carrying power of a four-wheel vehicle from 8 tons to, let us say, 50 tons, and much as I admire the beauty, from an artistic point of view, of a span of oxen, this will give us possibilities of speed, with bad roads or with no roads at all, at least four times as great as that attained by the docile ox, or even by the horse when walking. This is no mere visionary suggestion, but what I trust you will see before long demonstrated on a commercial scale, in the form of a self-propelled wagon capable of going anywhere, even climbing a kopje, drawing a useful load of from 100 to 200 tons, and opening up possible developments now financially hopeless."

POWER STATION NOTES.

BY E. K. S.

Belt Drives from Gas or Oil Engines.

It is a well-known rule in belt driving that the tight side should be at the bottom because it gives a larger angle of grip on the pulley. However, there are cases where this rule may very well be reversed as for example, when driving a dynamo from a gas or oil engine which does not run steadily. This is particularly the case where there is a flywheel on the dynamo. In such a case if the tight side is at the bottom the swing of the slack side of the belt is apt to be very violent, in some cases the belt will crack like a whip. Now, if on the other hand the slack side is at the bottom, then at each impulse the slack side slackens and the tight side tightens as the dynamo resists sudden changes of speed, the belt is pulled round the dynamo pulley, or, in other words, it slips. It will be readily seen that the proper place for the flywheel power is on the engine, not on the dynamo.

Battery Boosters.

The battery booster is one of the most tricky pieces of apparatus in a central station because of the wide variation of voltage required. Thus, with 220 volt lamps about 120 cells are required, the booster must be able to give about 100 volts to add on to the dynamo voltage of 220. Now, assuming the battery half discharged when commencing charging, the booster will be only required to give, say, 40 volts, or less than half the nominal pressure for which it is wound. For this reason the booster field must be separately excited, otherwise the voltage would be unstable. At times the circumstances of the battery may only require 20 volts and at this pressure it is almost impossible to prevent sparking owing to the weakened field. The best way to get over the difficulty is to reduce the speed of the booster when giving the lower voltages. If motor-driven, this is done by speeding down the motor, and if belt-driven, it may be done by having two speed pulleys.

Cleaning Electrical Machinery.

One of the most effective ways of cleaning electrical machinery is by means of a high-pressure air blast, and it is becoming more and more common for central electrical stations to be equipped with an air compressor for this purpose, even in isolated installations; for factories this auxiliary is useful because there is more chance of dust being about. In engineering works, for example, fine iron dust forms fringes on the poles of the machines and if it is not removed may give trouble. Of course, careful cleaning is more necessary with high-voltage short air-space machines, such as occurs in alternating current machinery.

The Dynamo Attendant's Diagnosis.

Dynamo attendants become very expert in diagonosing disease in the machines they have charge of, and one method, which is analogous to a doctor trying one's pulse, is to run the palm of the hand over the coils. By constant practice, an attendant will at once notice the slightest variation from the normal just as a nurse can tell to a degree the temperature of a bath. It should be noted that in the case of a coil heating more in one part than in another, it is the cool portion, not the hot, which is at fault, for it means that the cool portion is short-circuited.

Short-circuited Field Coil.

One of the more difficult faults to locate in dynamos or motors, is where one field coil is partly or wholly short circuited. In a two pole machine for example the only result in that the good coil does all the work of excitation, the other pole being for the time being a resultant one. There is no sparking to show the attendant that something is wrong, as with most other faults, and indeed the only way of knowing of the fault is by observing that the exciting current has increased, or by pushing the hand over the field coils. The one which is short-circuited will be cold whilst the other will be abnormally hot. It will be easily seen that where there are a number of poles, as in a multipolar, the cutting out of one coil by a short may have little effect on the excitation animeter reading.

Arranging Series Winding.

Many two-pole compound-wound dynamos are arranged with half their series turns on each pole, the two sections being connected respectively between one brush and one main terminal. It is important to note that this arrangement will not do where dynamos have to run in parallel, as in this case all the series turns must be connected between one brush and one terminal only. In the case of multipolar dynamos it is convenient to arrange all the series turns on one set of poles, say the north poles, as in this case it simplifies the connections considerably.

Connecting Leads in Power Stations.

In the paper on " Power Station Design," by Messrs. Merz and McLellan, before the Institution of Electrical Engineers, there are many footnotes which, in themselves, form a valuable contribution. Two of these deal with the question of connecting leads between generators and switchboards. It is pointed out that in large power stations it is best to place the switchboard at the side, and not at the end of the building, because the latter causes great concentration of leads running to the board, and it is practically impossible to avoid crossing the cables.

The authors are of opinion that it is unsafe to lay cables carrying large powers in tunnels or manholes, unless each cable is in its own duct or in some way protected by a properly earthed shield. When bare lead covered cables are run in manholes, the result of any one cable failing is that the others are affected, and serious arcs have been known to be started by the fusing of some minor wire. The authors advocate a complete copper shield, embracing all three cores of a three-phase cable, if an earthed iron shield or a separate brick or concrete duct cannot be used.

IRON AND STEEL NOTES.

By E. H. B.

Visit of the Belgian Engineers.

The Iron and Steel Institute had, during the month, an opportunity of reciprocating the good feeling which prompted the Liége Association of Engineers to welcome members of the Institute to Belgium in 1873 and again in 1894, and, needless to say, the utmost was made of the occasion. An interesting programme, embracing technical interests, commenced with a visit to the National Physical laboratory at Teddington, and the social arrangements made for the benefit of the visitors in London culminated in a very successful banquet given by the Iron and Steel Institute at the Hotel Cecil. In the absence of Mr. Andrew Carnegie, the chair was taken by Mr. E. Windsor Richards.

In proposing the toast of "L'Association des Ingénieurs sortis de l'Ecole de Liége," he remarked that that Association was the outcome of the School of Mines of Liége, founded in 1835. From time to time a succession of eminent engineers had indicated the paths of higher technical education that had been carefully and consistently followed, and had given to the school the renown it now enjoyed. Forming part of the University of Liége, with such men as Dwelshanvers, Dery, Habets, Gérard, Deschamps, and Breda as professors, it to-day held a front place amongst the world's technical schools. In 1847 the happy idea was conceived and carried out of forming an association of engineers of scholars from the School of Mines. The first president, who held office for thirty-eight years, was Louis Trasenster, whose name would never be forgotten in Belgium, and was greatly esteemed in England; and it was he who, on behalf of the Association of Engineers of Liége, received and entertained the Iron and Steel Institute at its first meeting on the Continent in 1873, during the presidency of Sir Lowthian Bell. The Liége Association's members now held important positions in every country. He mentioned especially Professor Albert Habets, a great authority on coal mining, and its present president, M. Jules Magery, the eminent ironmaster of Charleroi.

M. Magery, in thanking the chairman and the Iron and Steel Institute, said that, coming to England on the eve of the 75th anniversary of Belgian independdence, the Association could not afford to forget the great assistance England had rendered in the foundation of the Belgian State and the manner in which it had contributed from time to time to the maintenance of that independence. They were glad to take advantage of this happy occasion to thank England for all she had done up till now for the Belgian nation. He hoped her friendly sentiments would be continued, and that his little country would always find its best friends, as hitherto, in the powerful English nation. (Cheers.) In England they sought their first lessons which enabled them to exploit later the iron ore of Luxemburg or Lorraine, and they did not forget the fine reception always and everywhere given to them by English manufacturers. M. Magery concluded with tributes to Sir Lowthian Bell, Mr. Windsor Richards, Sir James Kitson, and other leading engineers and members of the Iron and Steel Institute, and particularly to the president, whose name, he said, would be engraved in gold letters in the history of the iron trade of the world.

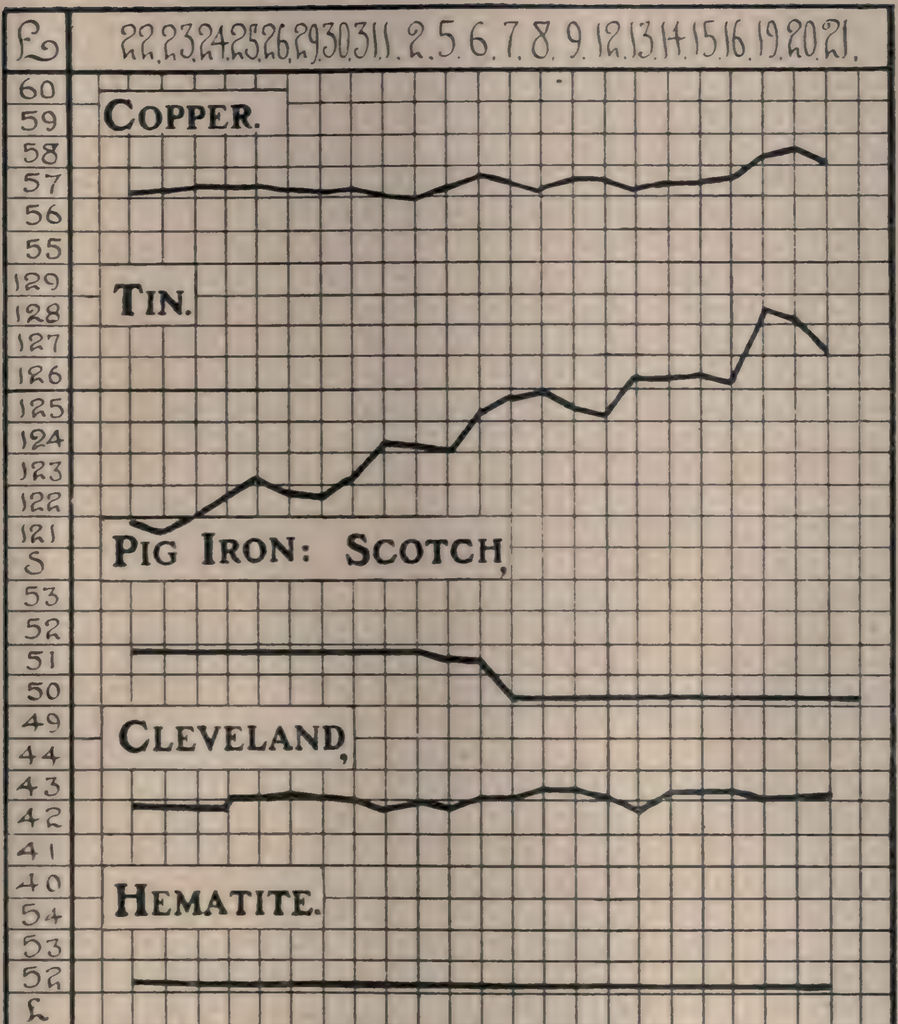
The statement that Mr. Carnegie and Mr. Windsor Richards had been elected honorary members of the Liége Association was greeted with enthusiasm.

The American Meeting.

A staple subject of conversation just now is the forthcoming meeting in the States of the Iron and Steel Institute. Among the names of those who have signified their intention of being present are the following:—

C. Allen, W. E. Allen, T. Atherton, C. J. Bagley, C. H. F. Bagley, W. R. Bates, Prof. H. Bauerman, P. Bayard, H. W. Bayliss, T. R. Bayliss, W. F. Beardshaw, L. Beijer, J. Bertram, G. G. Blackwell, G. Blackwell, Jun., J. M. Blair, C. E. Bloomer, J. E. Alger Blyde, Edwin Bond, A. Booth, Wm. Booth, Wm. Bright, B. J. Broadway, B. H. Brough, J. Dixon Brunton, C. E. Bunch, H. Butler, R. W. Burnyeat, Wm. Burnyeat, Thos. Campbell, E. Carlisle, T. Carlisle, A. Carnegie, E. C. Chalas, F. Cleeves, E. D. Cleghorn, A. Colley, Lieut.-Colonel J. H. Cowan, P. N. Cunningham, J. C. Custodis, W. S. Davie, Harry Davies, W. H. Davies, E. Dickinson, V. J. Diefenderfer, J. Donechay, H. S. Downe, E. Dreux, E. J. Duff, G. Ekman, E. Espinasse, Christmas Evans, C. K. Everitt, E. Farnworth, John Fellows, A. Firth, D. Flather, Sir Walter Foster, M.P., G. E. Fox, H. G. Graves, G. Watson Gray, R. A. Hadfield, W. Hartley, J. H. Harrison, W. R. Hay, A. P. Head, W. Hill, H. E. Hodgson, Wm. Hodgson, A. Horsfield, S. E. Howell, Herbert Hughes, J. C. W. Humfrey, C. James, Thos. Jenkins, C. L. Jones, Peter Jones, R. W. Kennard, James Kerr, J. Kidner, Sir James Kitson, M.P., R. D. Kitson, W. J. Larke, L. N. Ledingham, John Lees, John Bayley Lees, A. Lennox Leigh, David Lewis, W. R. Lewis, J. Little, J. Livesey, F. H. Lloyd, A. H. Longden, D. A. Lewis, D. C. Lysaght, T. B. Mackenzie, C. F. MacLaren, W. S.B. MacLaren, M. Magery, J. Magery, H. P. Marsh, E. P. Martin, Hugh Martin, H. F. Massey, W. H. Massey, H. Mechan, R. Melhuish, J. T. Middleton, S. V. Morgan, C. T. Needham, F. Noake, T. Noda, J. Paterson, V. Pendred, C. D. Phillips, R. Price-Williams, J. Proctor, A. S. Pye-Smith, J. Raine, B. M. Renton, Alleyne Reynolds, Windsor E. Richards, David E. Roberts, W. B. Roberts, L. S. Robertson, Sydney J. Robinson, T. B. Rogerson, F. T. Rollin, R. Russell, A. Sahlin, E. H. Saniter, F. Sauer, F. Scarf, P. Schmidt, Kilburn H. Scott, E. G. Sehmer, George E. Senior, A. G. Service, L. P. Sidney, F. C. Siemens, H. C. Simpson, D. T. Sims, Enos Smith, G. H. Smith, R. Sneddon, E. Steiger, S. E. Stevens, C. B. C. Storey, E. Storey, T. W. P. Storey, S. J. Summerson, T. Symington, B. Talbot, Hubert S. Thomas, F. Timmermans, John Timms, J. E. Touch, William Tozer, A. Turnbull, H. G. Turner, T. Turner(Kilmarnock), J. Verity, A. Vosmaer, H. H. Wake, R. Wallwork, M. Wardlow, H. Waterson, H. B. Weeks, Dr. A. Weiskopf, T. Westgarth, G. H. White, R. Whitehead, W. Whitwell, F. D. Wild, T. Wilkinson, Wilfred Williams, Colonel R. S. Williamson, G. P. Wincott, Sir Lloyd Wise, W. W. Wood, jun., J. Woods, R. G. Woodward, S. Young.

New York will be left on the 27th October, the excursion itinerary embracing Philadelphia, Washington, Pittsburg, Cleveland, Buffalo, and Niagara Falls. Those who wish to join the St. Louis trip will leave the main excursion at Pittsburg on the 3rd prox., and after spending three or four days in St. Louis, will return *via* Chicago and Niagara.



THE HOME METAL MARKET.

Chart showing daily fluctuations between August 22nd and September 21st, 1904.

MINING NOTES.

By A. L.

The Institution of Mining Engineers at Birmingham.

The meeting of the Institution of Mining Engineers recently concluded at Birmingham must rank as one of the most successful of recent years. The district abounds in points of interest for the miner, and at the present time when Birmingham is making such elaborate preparations to become the chief centre of mining instruction in the Midlands, the visit was particularly appropriate. Another feature which lent colour to the meeting was the participation therein of the Belgian visitors, and no one who heard their hearty response to the toast of their health, so ably proposed by Professor Louis at the annual dinner, could remain in doubt as to their enthusiasm and appreciation of the welcome so cordially extended. It was only natural, following the other hospitalities arranged for our Continental friends, that the Mining Institute should welcome them to their meetings and invite them in a friendly way to dinner. That this courtesy was appreciated was shown by the fact that the new president, Sir Lowthian Bell, and also Mr. James Cope Cadman, the able retiring president, had both been made honorary members of the Belgian Society.

When, I wonder, will the council see the wisdom of presenting papers in the abstract instead of presenting an extended programme, and according to a few members, the doubtful privilege of reeling off the *whole* of a technical paper at breakneck speed. The judicious circulation of papers in advance, and the reading of abstracts, would, in my opinion, do much to enhance the value of these meetings, while members would have more opportunity of indulging in a free interchange of ideas. I believe I have made this suggestion before, but as I have not seen any good argument against it I do so again without apology.

When the parent Society of Mining Engineers goes into the country, as it were, to visit its children, the work of organisation falls chiefly upon the local hon. secretary, and I am only echoing the opinion of the meeting when I say that great credit is due to Mr. Alexander Smith for the excellent programme arranged, and more particularly the excursions. Only those who have essayed to produce such a programme can adequately gauge the attendant difficulties and the insular prejudice with which certain firms, even in these enlightened days, object to an inspection of their works. The only drawback connected with the meeting at Birmingham, so far as I could see, was the small amount of practical work done.

The North of England Institute of Mining Engineers.

After all the excursion programmes of these meetings go a long way towards their success. The North of England Institute of Mining and Mechanical Engineers has just completed a very elaborate "excursion meeting," confining its attention to fresh air, observation, and the other allied concomitants associated with the official peregrinations abroad of learned and technical societies.

Here is the programme which commenced on Monday, September 19th :—

Excursion No. 1.—Wearmouth and Hylton Collieries, Roker Piers, Lloyds' Testing Works, and the Sunderland Engine Works of the North-Eastern Marine Engineering Company, Ltd.

No. 2.—(Limited to 30, none of whom were to be connected with the steel strade.)—The Newburn Steel Works of Messrs. John Spencer and Sons, Ltd., and the works of the Rolled Weldless Chain Company, Ltd., Lemington-upon-Tyne.

No. 3.—(Limited to 50.)—The Carville and Neptune Bank Power Stations of the Newcastle-upon-Tyne Electric Supply Company, Ltd., the Walker and Wallsend Works of Messrs. Swan, Hunter and Wigham Richardson, Ltd., and the Manors Power Station of the Newcastle-upon-Tyne Corporation Tramways.

No. 4.—St. Peter's and Forth Banks Works of Messrs. R. and W. Hawthorn, Leslie and Co., Ltd., and the Engineering Works of Sir W. G. Armstrong, Whitworth and Co., Ltd.

No. 5.—Dawdon Colliery, the Harbour Works of the Seaham Harbour Dock Company, and Horden Colliery.

No. 6.—Sulphur Recovery Plant at the Allhausen Works of the United Alkali Company, Ltd., the Works of Holzapfel's Compositions Company, Ltd., the Rope Works of Messrs. Haggie Bros., Ltd., and the Consett Iron and Steel Works, of the Consett Iron Company, Ltd.

No. 7.—The Northumberland Engine Works of the North-Eastern Marine Engineering Company Ltd., Wallsend-upon-Tyne, the Works of Messrs. Robert Stephenson and Co., Ltd., Hebburn-upon-Tyne, and the Consett Iron and Steel Works of the Consett Iron Company, Ltd.

No. 8.—The River Tyne, Dunston Coal Shipping Staithes of the North-Eastern Railway Company, the Works in connection with the Construction of the New High Level Bridge for the North-Eastern Railway Company, the Jarrow Works of Palmer's Shipbuilding and Iron Company, Ltd., and the Works of Sir John Jackson, Ltd., the Contractors for the Reconstruction of a portion of the North Pier.

No. 9.—The Redheugh Gasworks of the Newcastle-upon-Tyne and Gateshead Gas Company, Dunston Coal Shipping Staithes of the North-Eastern Railway Company, the River Tyne, the Works in connection with the Construction of the New High Level Bridge for the North-Eastern Railway Company, the Jarrow Works of Palmer's Shipbuilding and Iron Company, Ltd., and the works of Sir John Jackson, Ltd., the Contractors for the Reconstruction of a portion of the North Pier.

No. 10.—The Works of the Northern Wood Haskinising Company, Ltd., the River Tyne, the Jarrow Works of Palmer's Shipbuilding and Iron Company, Ltd., and the Works of Sir John Jackson, Ltd., the Contractors for the Reconstruction of a portion of the North Pier.

No. 11.—The North-Eastern Railway Company's Locomotive Works at Gateshead-upon-Tyne, and the North-Eastern Railway Company's Transforming Stations and other Works connected with the Electrification of the Newcastle-upon-Tyne and Teignmouth Railways.

A surfeit indeed. I was unable to participate in these joys, but can only suppose that the secretary, Mr. Walton Brown, had his work cut out in arranging this programme. It is difficult to conceive how all the items were got into the scheme, but, of course, it was no more possible for a single miner to book the whole of the eleven than it was for him to attend the three luncheons set down for September 22nd, with the attendant cost in matter of fact half-crowns.

In addition to the foregoing, members had an opportunity of paying a visit to the silver and electro-plate manufactory of Messrs. Elkington and Co., the metallic pen factory of Messrs. Joseph Gillott and Sons, Messrs. F. and C. Osler's glass works, the engineering establishments of Messrs. Bellis and Morcom (Birmingham), and Messrs. Willans and Robinson (Rugby).

THE CIVIL ENGINEER AT WORK.

BY C. H.

Sunderland Bridge Project.

One of the largest bridge contracts undertaken in England for some years will be the new bridge over the Wear at Sunderland, carrying both road and rail. This structure will be of steel in four spans with arched approaches. The total length of the bridge (including 930 ft. in actual spans), will be 1,582 ft. It will be built in accordance with the designs of Mr. C. A. Harrison, engineer of the Northern Division of the North-Eastern Railway.

New Lighthouses.

Mile Rock, at the entrance to the harbour of San Francisco, is to be provided with a steel lighthouse. The rock is a precipitous one, standing 16 ft. above mean low water. The structure will have a concrete base 34 ft. high, plated with iron, and built in the form of an ellipse. Compressed air will be used to sound the fog-whistle, the compressors being operated by 20-h.p. Hornsby-Steroyd oil engines. The entire structure will be painted white, and the keepers will maintain communication with the shore by telephone.

A lighthouse has been completed by the Government of Canada at the northern end of the shoals of St. Roch, in latitude north 47 deg. 21 min. 21 sec., longitude west 70 deg., 15 min. 12 sec. This light is also built upon a steel sheathed concrete pier, and the lantern, at a height of 55 ft. above high water mark, will give a white flash every five seconds. This lighthouse has also a fog-alarm, operated by compressed air. It is described as a rectangular building, with concrete walls, and a mansard-roof, the tower portion forming a wing to the main building, surmounted by a cylindrical iron tower.

Fog Signals at Sea.

According to Vernon-Harcourt, the most powerful fog signal consists of the blasts of a siren trumpet actuated by compressed air at a pressure of from 20 to 28 lb. per square inch; and the deep note produced by 326 vibrations per second has been found very suitable and is heard further off than a high note with the same expenditure of air. With a consumption of about 14 cubic feet of air per second, a siren with a drum of 6 in. in diameter has been found to give the best results. The most powerful sirens cease sometimes to be audible beyond two sea-miles; but their range extends generally to at least four sea-miles, and, under favourable conditions, may be much greater.

More about Nile Irrigation.

I have received from the publishers, Messrs. E. and F. N. Spon, Ltd., a very interesting volume with five plates, which gives in English, French, and Arabic the text of the paper read before the Khedival Geographical Society at Cairo by Sir William Willcocks, K.C.M.G., M.Inst.C.E., on the "Assuan Reservoir and Lake Moeris." The manner in which Sir William proposes to provide perennial irrigation for two million acres, and so add £60,000,000 to the wealth of the country, has already been alluded to in PAGE'S MAGAZINE. The complete project for the perennial irrigation and flood protection of Egypt contemplates the following works:—

Raising the Assuan Reservoir (two years)	£500,000
The Wady Rayan or Lake Moeris Reservoir (four years)	2,600,000
River protective works in Lower Egypt (five years)	900,000
River protective works in Upper Egypt (ten years)	900,000
Total..	£4,900,000

To these have to be added the approximate estimates of the works on the Upper Nile:—

Regulator for Lake Victoria Nyanza (four years)	£400,000
Regulator for Lake Victoria Nyanza (four years)	400,000
(With respect to the above, it must be remembered that the Uganda Railway is now working and capable of transporting materials.)	
Dredging and river training in the Sudd regions for 25 years at £100,000 ..	2,500,000
(Two or three years' steady work with two or three dredgers and three or four hundred convicts will indicate the direction in which the operations should be conducted.)	
Total..	£3,300,000

The total expenditure amounts to £8,200,000, spread over twenty-five years.

Irrigation Prospects in India.

So much has been heard lately of the schemes promulgated for the benefit of Egypt, that one is apt to overlook the immense possibilities of India as a field for irrigation. In the excellent financial and commercial supplement with which the "Times" supplies its readers at regular intervals, a correspondent draws attention to vast tracts of the great Indian continent waiting for the engineer, and only needing water, properly applied, to make them yield a bounteous harvest. He states that no really serious obstacles, or at all events no absolutely insurmountable ones, are placed in the way of private enterprise. The extent of land irrigated by means of private-owned canals is about 1,500,000 acres, or one-hundredth of the entire cultivated area. Some companies which engaged in this description of work in the past were failures. At the same time, it ought to be said that they were born rather before the era of modern joint-stock concerns, when investors were not easily parted from their savings and large capital subscriptions were unknown. These Madras irrigation projects began with too little money, and they ended with too little. The prospects, like the opportunities, are vastly different to-day. Bengal still needs much to be done to assist nature; in Assam there is scarcely any systematised effort at irrigation; in short, there is in all India upwards of 106 million acres of uncultivated land still available for irrigation works. The profits would be good, but the undertaking is not of the cheap class. As an indication of cost, it may be mentioned that the new reservoir to be made by the Government on the Betwa Canal in the United Provinces will mean alone an outlay of ten lakhs of rupees, or, say, £66,000 sterling. He adds that settlers are always willing to take up land in newly-watered districts, and to pay for the water used. Witness Hissar and Sirsa after the famous Western Jumna Canal had been extended to them. They are secured for ever against famine. Look again at Sind with its slight rainfall. In twenty years the area in cultivation increased by 50 per cent. The Bari Doab Canal is another great piece of engineering; it doubled the extent of the crops round about Lahore and Amritsar. Many additional instances could be cited, especially of the benefits arising from the relatively less costly forms of irrigation by tanks, wells, etc., as exemplified in Madras.

The Panama Canal.

According to a writer in the "Electrical Review" of New York, it will require from six to ten years to complete the Panama Canal even under modern engineering conditions, and from one to two years of preparation will be required. There will hardly be a machine, repair shop or operating plant that will not have electric power in some portion of it. In this respect the new machinery for the Panama Canal will differ radically from that shipped to the isthmus by De Lesseps and his engineers. Within six months the designs and specifications of some of this machinery will be finished, and the first shipments will probably be made within the current year, or the early part of the new. Electrically-driven conveyors, cranes and drills will be very much in evidence, and it is proposed to light up the route of the canal by electricity, so that work can be carried on in shifts night and day. It is very possible that for fuel purposes, Texas oil will be largely used.

Railways in Western Asia.

In the course of a paper on this subject, read at a meeting of the Central Asian Society, Lieutenant-Colonel H. Picot said that Syria was being rapidly opened up by a well-conceived system of railways, subsidiary to the more ambitious schemes of Asia Minor and Mesopotamia. Taking Kilis or Birejik as the point of junction on the future Baghdad Railway, we might at no very distant date be able to traverse the whole of Syria in its length from north to south. The prolongation to Medina and Mecca would be the first step at breaking ground in Arabia, and must lead to great economic and social changes in that portion of Asia. That British enterprise and capital should have so little part in the opening of Syria by road and rail was not surprising. The political influence of France was for long supreme in Syria, and we could, he thought, have viewed an increase of that influence with perfect goodwill, but French influence was on the decline. The most suggestive factor in the present economic situation in Syria, to his mind, was the entry *en scène* of German agencies for the financing and construction of its railways. German engineers, trained on the Anatolian Railway, were now supervising the construction of the Haifa-Damascus and the Hejaz railways, the Sultan's own pet schemes, and there seemed no doubt that German financial assistance would be offered and probably accepted when the cash resources of the Sultan's civil list became exhausted.

COMING EVENTS.—OCTOBER.

3rd.—Society of Engineers meet at 7.30 p.m.—Opening of an International Engineering Congress under the auspices of the American Society of Civil Engineers, at St. Louis Exposition.—Institute of Marine Engineers meet at Stratford, E.—South Staffordshire and East Worcestershire Institute of Mining Engineers meet at the Birmingham University.—South Wales Institute of Engineers meet at Cardiff, 3 p.m.

6th.—Civil and Mechanical Engineers Society meet at 8 p.m.

8th.—Conclusion of the International Engineering Congress at St. Louis Exposition.—North of England Institute of Mining and Mechanical Engineers meet at 8 p.m.

10th.—Institute of Marine Engineers meet.

13th.—Institution of Electrical Engineers meet at 8 p.m.

17th.—South Staffordshire and East Worcestershire Institute of Mining Engineers—Annual meeting at 3 p.m., in the Birmingham University—Presidential Address by Prof. R. A. S. Redmayne.—Institute of Marine Engineers meet.

18th.—Institution of Engineers and Shipbuilders in Scotland meet in Glasgow.

20th.—Institution of Mining and Metallurgy meet at the Geological Society's Rooms, Burlington House, at 8 p.m.

21st.—Institution of Mechanical Engineers meet at 8 p.m.—North-East Coast Institution of Engineers and Shipbuilders—Annual meeting at Newcastle-on-Tyne.

24th.—Institute of Marine Engineers meet.

27th.—Institution of Electrical Engineers meet at 8 p.m.

OUR TECHNICAL COLLEGES.

BELFAST TECHNICAL INSTITUTE.

At Belfast Mr. R. Stanley, B.A., A.M.I.E.E., in the course of a lecture in connection with the Municipal Technical Institute on "Electrical Engineering as a Profession," took the opportunity of stirring up employers and manufacturers, remarking that they would have to give considerably more help to technical schools than they had been doing. Their duty did not end with paying their rates, whatever they might be. It was high time to give up the idea that the success of a man depended on the size of the premium he could pay. In America they asked no premium; they looked for brain power, and gave a living wage from the start.

The Principal (Mr. F. C. Forth), referring to the Institute building in course of erection, said that when equipped it would be second to none in the United Kingdom, but if that building was going to be worth anything it would not be because of its handsome appearance or the quality or excellence of its equipment. It would attain its mark when the young men of the city rose to the advantages that the municipality had placed at their disposal. Then it would justify the great expenditure being made upon it, and then he thought Belfast would have no reason to cry second to Germany, America, or any other part of the globe.

BIRMINGHAM UNIVERSITY.

The opening of the new metallurgical smelting-house at Bournbrook marks an important stage in the history of the University, and as Professor Turner remarked in his introductory lecture, no course so ambitious as that proposed has hitherto been attempted in England. While there can be no question but that the metallurgical progress of America and Germany has been largely owing to the superior equipment of their schools, the expenditure of some £10,000 upon this new smelting-house may be taken as an indication that we are really "waking up." Professor Turner incidentally said that although we had not given the attention to the subject which it demanded, few districts were better equipped in the matter of technical schools than that around Birmingham, and none could supply so good a list of honours obtained in the examinations of the Board of Education. It might be supposed that that was sufficient, but there were important limitations which prevented these schools from covering the ground that could be covered by a school of metallurgy in connection with a large university. Granted that metallurgy was to form an integral part of university study, the question arose on what lines should the teaching proceed, and what equipment should be provided. Two styles of training had been recommended—that adopted by Dr. Percy at the Royal School of Mining, and that in vogue at the newer schools of mines and metallurgy in America. Out of those there arose what he regarded as the system which they had endeavoured to imitate at Bournbrook. The old schools of metallurgy were either too exclusively theoretical or too exclusively practical. At Bournbrook they would combine theory with practice; students would analyse their ore, decide which was the best process of extraction, and then extract it. No course so ambitious had been attempted in England before, and he was quite sure they would get some very useful experience from it. They could not absolutely imitate the ordinary steel works, because there would be a loss on all they made, and therefore they must endeavour to get the largest amount of instruction out of the smallest amount of metal. The importance of their equipment was that, although they did not actually imitate works, they acquainted their students with the conditions of the furnace, considered as a piece of mechanical and metallurgical scientifie apparatus.

THE TRANSVAAL TECHNICAL INSTITUTE.

A "Times" Johannesburg correspondent gives an interesting account of the Transvaal Technical Institute, the opening of which I chronicled some time ago. It is remarked that within six months of the Technical Education Commission signing its report, the Institute virtually inaugurated its first classes.

By agreement with the educational authorities of Cape Colony it was arranged that the institute should take over the classes in mining engineering which have been held for the last eight years at Kimberley, supported financially by the De Beers Company and the Cape Government. These classes formed the third and fourth years prescribed by the Cape University for its diploma and degree in mining engineering, and at first it was expected that the institute would have to content itself with this modest start. But the arrival of Professor Hele-Shaw, of Liverpool, who was charged with the organisation of technical education in the colony, in co-operation with the council appointed for this purpose, has infused more energy into the scheme, and the institute has been brought into being on far more ambitious lines. The curriculum now embraces a complete four years' course of engineering and of mining. A general course, including mathematics, chemistry, geology, and other allied subjects, will occupy the first three years; at the end of this time students can "specialise" for one year in any one of the following branches: (*a*) mining, (*b*) mechanical engineering, (*c*) electrical engineering, (*d*) civil engineering.

Arrangements are under consideration to enable students from the Royal College of Science and other bodies at home to proceed to the Transvaal for a post graduate year's study. With the most praiseworthy liberality, adds the correspondent, several of the mining houses are willing to provide positions on the mines at a small salary for such students.

As an appendix to the foregoing I must quote Professor Hele-Shaw. On a recent public occasion, at the conclusion of a lecture he alluded to his forthcoming departure for England, remarking that he had never appreciated working anywhere more than he had in Johannesburg. He was pleased that what little he had tried to do since he came to the Rand had been appreciated.

OPENINGS FOR TRADE ABROAD.

France.

Government sanction has been obtained for the construction of a floating dock at Bordeaux. The estimated cost of the work is £320,000.

In order to facilitate the working of the phosphate mines of Kalaa-Djerda, the Government of Tunis has decided to proceed with the construction of a branch line joining Kalaa-Djerda with the railway from Tunis to Kalaa-es-Senam.

The Chamber of Commerce at La Rochelle will shortly invite offers for the installation of a crane on the quay of La Pallice Dock. The lifting power of the crane desired is 30 tons. The beam, or the part which projects over the water or vessel alongside, should be long enough to unload from a point about 26 ft. 6 in. from the edge of the quay. The height of the distal end above the quay should be 15 metres (49·21 ft.); the vertical distance between the edge of the quay and that part of the crane directly over it, 8 metres (26·4 ft.). A locomobile is preferred, but should the conditions be unfavourable for installing such a machine, then a fixed crane would be adopted.

Switzerland.

A concession has been granted for the construction and working of a narrow-gauge electric railway from Schöftland to Sursee. The cost of the work is estimated t about £60,800.

Italy.

A consular report from Rome states that automobilism in that city is increasing; the Consul is of opinion that a good local agency for the sale of British motor fittings, etc., would do a remunerative business.

Sweden.

The British Vice-Consul at Halmstad reports that the syndicate formed for constructing a new railway line to connect that port with Falköping, has obtained its concession, and the line, which has a length of eighty-five miles, is now being built. It will cost about £350,000, and is expected to be completed at the end of 1906. The rails are already bought in the United Kingdom.

Natal.

A Board of Trade correspondent in a recent communication from Port Natal reports that the bill to empower the Town Council of Ladysmith to borrow £35,000 for the improvement and extension of the water supply of the town, and another authorising the Town Council of Pietermaritzburg to raise £200,000 for the completion of the waterworks there, have passed through the Legislative Assembly, and will no doubt be passed in due course by the Upper House.

New Zealand.

A New Zealand correspondent writes asking for particulars of a brick-laying machine. We shall be glad to receive replies at this office from any reader able to supply the required information.

Japan.

Consular report from Shimonoseki states that a branch line from Usa on the Kiushiu Railway to Oita City, distance 40 miles, has been officially sanctioned, also a short line of 1¼ miles from Kawasaki station, on the same Company's line, to the coal mining district of Taito in Fukuoka Prefecture.

Nicaragua.

A body of engineers has been commissioned by the Government to draw up plans for the construction of a railway from San Miguelito to Punto Mono.

Lagos.

At a recent meeting of the Legislative Council, the sum of £9,000 was voted for the construction of a slipway and marine workshop, and £5,000 for the construction of waterworks.

Egypt.

A Khedival decree has been published authorising the construction of a light railway for agricultural purposes between Sahragt and El-Kanayat. This line is to form one of those which the Egyptian Delta Light Railways Company have received authority to establish in the provinces of Dakahlieh and Charkieh.

Brazil.

Tenders, which will be received up to October 22nd by the Secretary of Agriculture, Bahia, are in demand for the construction of the first section of the line from Ilheos to Tabocas, fifty-eight kilometres in length, narrow gauge.

Considerable expenditure in connection with railway lines is contemplated. The authorised programme includes the following operations and extensions, viz., to extend the Melhoramentos Railway to join the Rio d'Ouro line at Sande, and abandon the section between that point and Sao Francisco Xavier; to complete the Porto Alegre to Uruguayana, and Pernambuco to Pesqueira lines, and branches to Santa Anna do Livramento; to widen the gauge of the Central from Jaubaté to Sao Paulo; to complete the branch to Penha, and extend the Donna Theresa Christina Railway to Ararangua and Massiambu, and the Conde d'Eu to Campina Grande and Batalhao or other convenient point; to complete the Mundo Novo branch of the Central Bahia Railway; to extend the Baturité line to Crato, and the Sobral line to Therezina; to construct a railway in Rio Grande do Norte, starting from a point on the coast, to traverse the districts suffering from drought.

NOTABLE BRITISH PAPERS.

A Monthly Review of leading Papers read before the various Engineering and Technical Institutions of Great Britain.

MECHANICAL DRAUGHT FOR BOILERS.

THE pressure or intensity of the draught fixes the amount of fuel it is possible to burn on a given area of grate. It therefore becomes necessary, when it is desired to increase the steaming capacity of a boiler by increasing its coal consumption, to increase the intensity of the draught, and the only way in chimney draught is to increase the temperature of the gases passing up it, or increase the height of the chimney. The first method, of course, means a large amount of waste, and is a very uneconomical arrangement; the second is expensive and unusual.

A chimney stack 150 ft. high will burn from 15 lb. to 20 lb. of coal per square foot of grate area per hour under normal conditions, but in wet or foggy weather it will be very much less than this, as the wet air is lighter than the dry, and thus produces less pressure at the furnace (the weight of water vapour is about half that of air).

A fair average of temperature in the furnace is 2,400 deg. Fahr., and that of the escaping gases at the chimney without economisers, 600 deg. Fahr. This means that one-quarter of the total heat generated is sent up the chimney to waste. Thus, on a 2,000 h.p. plant, almost 500 h.p. is going up the chimney per hour, and the coal bill necessary to sustain this will come to a big figure in the year.

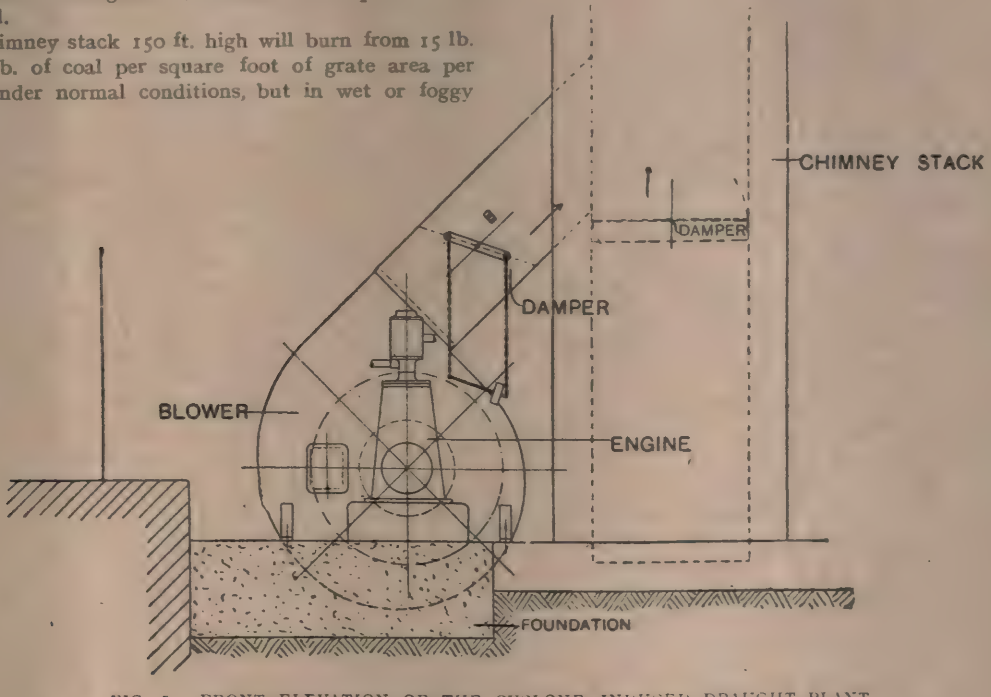


FIG. 1. FRONT ELEVATION OF THE CYCLONE INDUCED DRAUGHT PLANT.

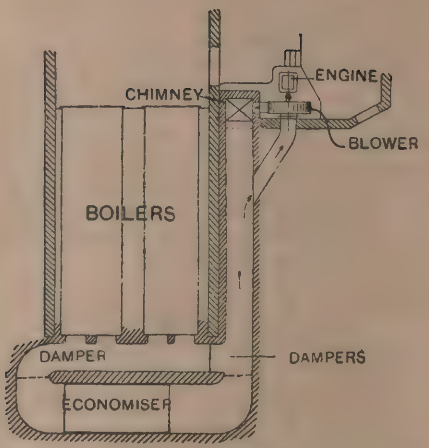


FIG. 2. GENERAL ARRANGEMENT OF THE INSTALLATION.

Suppose we could reduce the amount of air accompanying each pound of coal from, say, 24 lb. to 12 lb. (the chemical requirement), and the temperature kept the same, then we would only send one-eighth of the total power up the chimney, and save one-eighth of the coal bill at the same time. The temperature in the furnace would then be greater; the heat generated greater, and, of course, the temperature of the gases at chimney less.

The effect of the draught and the air supply to boilers having been demonstrated to be of such importance, we are brought now to the consideration of the best means of producing the requisite draught, and it is not only the author's contention, but it has become a well ascertained fact, that it is cheaper and better in every way to provide the necessary supply of air for burning fuel in steam boilers by mechanical means, and to take as much heat out of the hot gases after they have ceased to be in contact with the boiler itself before they are turned out into the atmosphere, than to do it in the older way by utilising a portion of the heat generated to create the necessary supply of air.

This is the primary reason for using a mechanical means of moving the air. The heat previously necessary to create the draught by means of a chimney may now be employed usefully in other directions.

STEAM JETS.

There are several forms of mechanical draught, and perhaps the first step in that direction is the use of steam jets. These are certainly the most expensive means on an ordinary land installation of Lancashire, Cornish, or water-tube boilers. They may be applied at the fire, or in the chimney, as in the case of a locomotive boiler. In the latter case, the exhaust steam from the engine is used, and excellent results are obtained.

But it is with fan draught that this article is intended more particularly to deal. Fan draught may be divided into two distinct classes, viz., forced and induced. Forced draught may again be subdivided into two methods, viz., first, closed stokehold, and second, closed ashpit.

CLOSED STOKEHOLD METHOD.

The first, or closed, stokehold method, is almost exclusively used for ship work. Here it is possible to entirely close up the stokehold and drive air by means of a fan into it, raising the pressure as shown on an ordinary U tube water gauge, to about 2 in. The only outlet for the air is through the furnaces, and where this method can be adopted it is undoubtedly the best, as a minimum of fan power is required, due to cold air only having to be handled. (It must be remembered that the hot gases leaving a boiler are practically double the volume of the air entering the furnaces, due to expansion from rise of temperature.) The air passes both through the fire from the ashpit, and over the fire through the firedoor, the latter assisting largely in preventing smoke.

CLOSED ASHPIT SYSTEM.

For land work or stationary boilers, however, this method can scarcely ever be adopted, and if a forced draught system is desired, the closed ashpit must be resorted to. Here, again, a minimum fan power is required, as cold air is being handled, but there are several disadvantages, which, in the author's opinion, far outweigh any saving which might be effected by using the smaller fan, as for instance:—

(1) Initial cost of furnace fronts is very high, say £16 per furnace, and these are frequently needing repair.

(2) Fires do not burn so evenly.

(3) The air supply must be shut off before the fire door is opened, or the stoker would run grave risk of being burned through the pressure forcing the heat and flames outwards. (Automatic appliances have been tried, but are not always a success).

(4) The pipes conveying the air to the furnaces are very much in the way, and are usually very unsightly.

INDUCED DRAUGHT SYSTEM.

In the author's opinion, by far the best method of obtaining draught by mechanical means is the induced draught system, wherein the fan is placed between the boilers and chimney, or point of discharge of waste products into atmosphere.

By such an arrangement the coal consumption may be increased from the 15 lb. to 20 lb. per square foot of grate in chimney draught to 30 lb. to 40 lb. per ft. under ordinary conditions, and beyond this amount under special circumstances. This results not only in a proportionate increase of steaming capacity in the boilers, but in greater efficiency of combustion, and consequent economy.

Most steam boiler plants nowadays are provided with economisers of the Green's, Lowcok's or similar type. Where such is the case, an opening is made in the flue between the economisers and chimney, and the fan inlet connected thereto by a short brick or metal flue. Another opening is made in the main flue at a point nearer the chimney, or into the chimney itself, and this opening is connected to the fan outlet in the same way as to the inlet.

Between the openings, and inside the main flue is placed a damper, so that all gases, after leaving the boilers, must of necessity pass through the fan on their way to the chimney, so long as the aforementioned damper is closed. It is also customary to place dampers both at the inlet and outlet of the fan, so that by manipulating these two and the one in the main flue, the fan may be cut out, and natural draught resorted to in case of necessity.

The same arrangement applies where no economisers are installed, and in such cases the fan handles the gases at the high temperature at which they leave the boilers. Of course, in either case special arrangements must be made in order to keep the bearings cool, either by water-jacketted bearings, or an arrangement of air cooling.

THE SYSTEM AT WORK.

Fig. 1 shows front elevation of a cyclone induced draught plant, such as described and installed by the author's firm in the Manchester district.

This is a small installation for two boilers only, as will be seen from the general arrangement, fig. 2. In this arrangement the main flue was tapped and a connection made to the fan inlet, the fan outlet being connected direct to the chimney as shown clearly in fig. 1.

Instead, however, of putting a damper in the main flue, it was more convenient to place it in the chimney, as shown in fig. 1, the effect of course being the same.

The fan in this case is driven by a direct connected enclosed type steam engine, the combination running at about 600 revolutions per minute. The plant was put in for two reasons. In the first place great difficulty was experienced in keeping steam, and in the second place, the hard firing necessary in the effort to do this, naturally resulted in volumes of dense smoke being emitted from the chimney stack, for which the firm were prosecuted more than once.

The fan enables steam to be kept with ease, and has entirely cured the smoke nuisance; only a light smoke can be seen being emitted from the chimney.

Another installation is illustrated by the plan shown in fig. 3. In this instance the fan inlet is placed close against the main flue, and again the outlet or delivery is through a connection into the chimney.

It will be noticed that the fan shaft goes right through the flue to a bearing on the opposite side. This was necessary as the fan is a large one, and an overhung wheel was not desirable.

It is interesting to note the results accruing from this installation. One boiler after another had been added to those put down when the works and chimney were built. As a natural consequence the draught had become totally inadequate, resulting in insufficient steam, and smoke trouble. A new chimney was contemplated, but the proprietors were persuaded to try a fan first. The net results after twelve months' trial were :—

(1) An ample supply of steam under all atmospheric conditions.

(2) A discontinuance of the smoke nuisance.

(3) Retention of the old chimney, thus saving the cost of a new one ; and

(4) A saving of exactly 25% of the year's coal bill, through being enabled to burn an inferior quality of coal.

It is perhaps worth while to note this saving more than paid for the induced draught plant in the first year's run.

Still another arrangement is shown by fig. 4. This is very similar to the last, the principal difference being in the method of driving. Being a town electric lighting station, the authorities preferred to drive by motor and belt.

The very satisfactory results secured by a system of induced draught are due to a less volume of air being required, though at a higher pressure than with chimney draught. A chimney usually works at a vacuum of ½ in. to ¾ in., while an induced fan is generally arranged to give 1½ in. to 2 in. In consequence of this, thicker fires can be carried, and higher temperatures maintained, resulting in more rapid

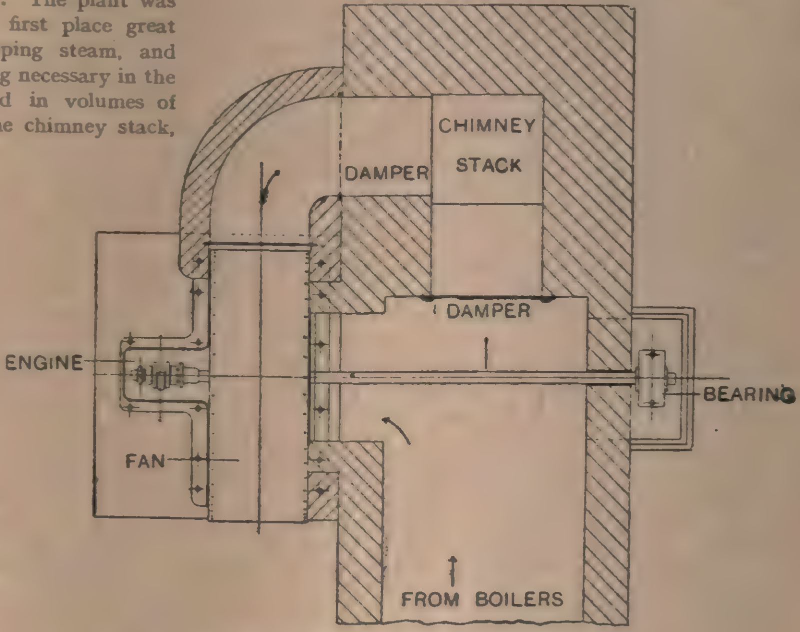


FIG. 3. ANOTHER TYPICAL INSTALLATION.

conduction of heat through the heating surface, and therefore a greater economy of heat than with chimney draught.

This high temperature of combustion and consequent increase of evaporating power of the boilers is such that usually three boilers, with induced draught, will do the work of four with chimney or natural draught. Occasionally better results even than these have been secured. One advantage of induced over forced draught is that a better and more even distribution of air is obtained.

ARGUMENTS FOR INDUCED DRAUGHT.

One of the best arguments in favour of induced draught is that by it the pressure may be kept practically constant, and consequently the temperature, so that the boiler shell and furnaces do not contract and expand to the same extent, thus saving large sums of money in repair bills for leaky joints and rivets.

It is not always possible to keep boilers idle when an induced draught system is introduced to an existing plant, as where one or two boilers may be installed. In such a case an alternative is to reduce the length of the fire bars, and by keeping thicker fires to secure the beneficial results already described.

One of the most valuable features of an induced draught apparatus is that it enables the high temperature upon which a chimney depends for its results to be dispensed with. In fact, the more heat abstracted from the gases by economisers and such like apparatus for heating water, air, etc., the better it is for the fan.

These are days when profits are made—or, at all events, augmented—by economies at all points, and insufficient attention has been paid in many installations to the possibilities in this direction. Not only may the boiler feed water be heated by economisers, but in works where quantities of hot water are required for manufacturing purposes, such may also be obtained in the same way. And again, in manufacturing establishments, laundries, etc., where hot air is required for drying or similar purposes, this also may be obtained by economiser pipes just as hot water is.

An induced draught fan renders the plant it is working with quite independent of climatic conditions. A chimney that will just do its work on a clear cold day, may give considerable trouble in damp or foggy weather, but a fan is always positive and alike. It is also more flexible, and under control, rendering it capable of answering to sudden calls. In the case of an electric light station, for instance; if a heavy fog comes on there is a big rush for current, and consequent heavy demand on the boilers. If chimney draught has to be depended upon, it will be at its worst under such conditions, but a fan would not be affected by the fog, and would answer at once to the demand made upon it.

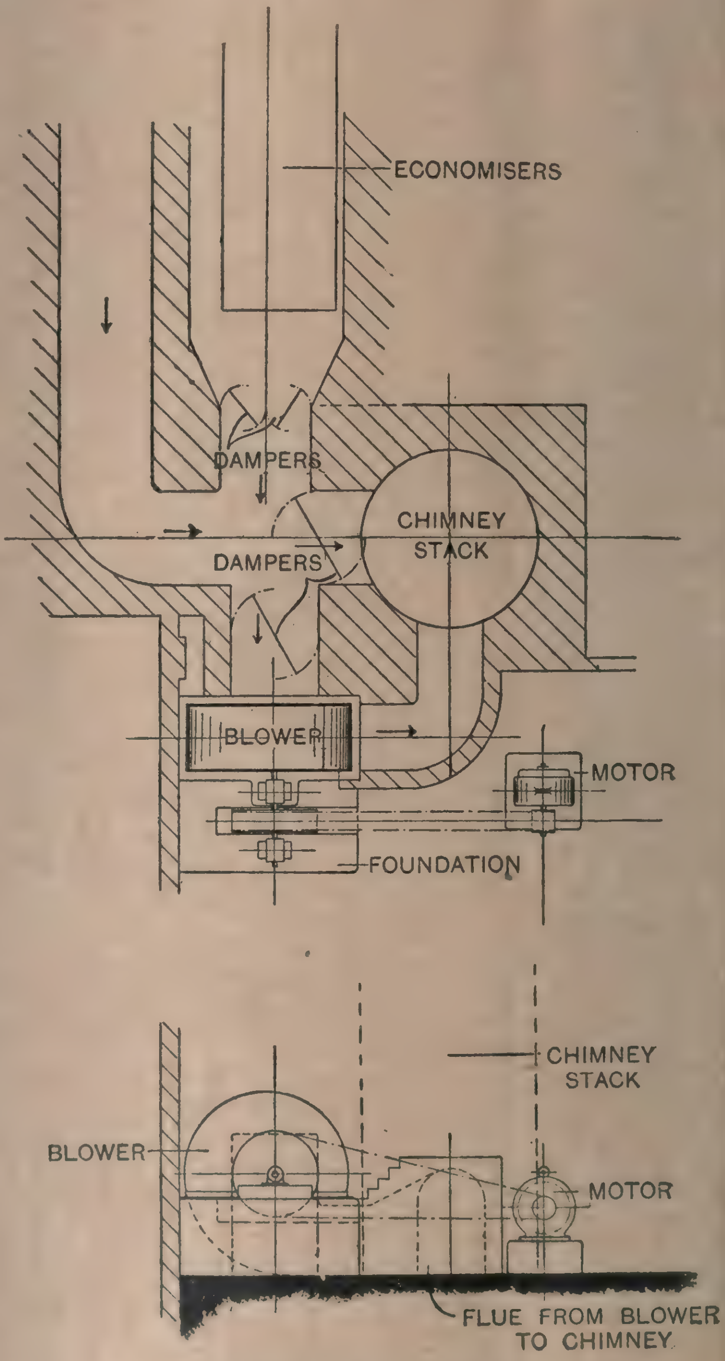


FIG. 4. INSTALLATION WITH MOTOR DRIVEN FAN.

Again, in consequence of the intensity of fan draught, it is possible where such sudden demands for steam are likely to be made, to keep fires banked up and dampered down, and then when required, to have them in full blast in a few seconds.

SMOKE PREVENTION.

Mention has also been made of the value of an induced draught fan as a smoke preventer. Public authorities are daily increasing their vigilance, and woe betide the firm that belches its black smoke into the atmosphere, polluting all the surroundings. But this is not all. This black smoke, as pointed out earlier in the paper, is unconsumed carbon, and, therefore, waste. So on all accounts it is desirable to stop it.

A properly designed and arranged induced draught plant will accomplish this, as already stated, by increasing the temperature of combustion and thus make the boiler consume its own smoke, or to put it another way, by enabling the proper chemical changes to take place in the furnace, to obtain immunity from smoke trouble.

A very important point not yet touched upon, and particularly applicable to buildings projected, is the question of the chimney in relation to induced draught. A stack higher than that necessary to carry the gases above the surrounding property, say about 50 ft. high, is useless where an induced draught fan is at work. It therefore pays to consider the question of fan *versus* chimney in the matter of first cost, and also as to economy of space.

[From a paper read at the summer meeting of the Institution of Heating and Ventilating Engineers (Incorporated).]

ELECTRICITY FROM WATER-POWER IN THE BRITISH ISLES.

ONE of the most interesting papers read before the Engineering Section at the recent meeting of the British Association was that by Mr. A. A. Campbell Swinton on "Electricity from Water-Power." The following details were included concerning prospective water-power schemes in the British Isles:—

THE FOYERS INSTALLATION.

The only large-scale plant for the production of electricity by water-power at present in operation in this country is the well-known installation of the British Aluminium Company at Foyers. This installation, which was originally designed by the late Mr. Birch and carried out by Mr. W. Vaux Graham, has been at work ever since the year 1896, and the whole of the power is employed for electro-chemical purposes on the spot. A small percentage of the power is utilised for the production of calcium carbide, but the bulk is, and in the near future the whole of the power will be, used for making aluminium. At present the gross horse-power of the plant is 7,000 h.p., but plant for a further 2,000 h.p. is at the present moment being installed, and will be working in about a month's time.

The water is derived from the River Foyers, which has a catchment area of upwards of 100 square miles. Storage is effected by means of two lakes, which have been joined together by the raising of dams and embankments, the result being a continuous lake of about 5½ miles long by about half a mile in width. The storage thus obtained is sufficient to run the entire plant continuously day and night for about fifty days.

From the River Foyers the water is first passed through a tunnel 8½ ft. in diameter, cut through the solid rock, to the penstock chamber, from which the water is delivered by separate cast iron pipes to the turbines, which are installed on the shore of Loch Ness, and into which the water is finally discharged, the available head of water being 350 ft.

LOCH LEVEN SCHEME.

The British Aluminium Company have obtained parliamentary powers for a further large water-power installation on Loch Leven. It is their intention to commence immediately the development of this scheme, which is capable of giving 17,000 gross horse-power. The reservoir is artificial, and will contain about 150 days' storage of the full power, the head of water at the turbines being 964 ft. It is anticipated that the whole of this power will also be taken up in the manufacture of aluminium on the spot, no distant transmission being at present, at any rate, contemplated.

POWER FROM LAKE LLYDAW ON SNOWDON.

Another interesting water-power scheme of considerable dimensions is at the present moment being developed in Wales by the North Wales Electric Power Company, who have obtained parliamentary powers for this purpose. Their first installation is at present being erected under the superintendence of Messrs. Harper Bros., the company's engineers, and derives its power from Lake Llydaw, on Snowdon. This lake, into which runs the water from Lake Glaslyn, is about 1⅕ miles in length, and about a quarter to half a mile in width. Its area is 5½ million square feet, and it derives its water from a catchment area of about 1¾ square miles, including the summit of Snowdon. Being in the track of the Atlantic depressions, this area has one of the heaviest rainfalls in Europe, amounting on the average to 180 in. per annum. In 1903 it reached the phenomenal figure of 250 in. The prevailing winds are from the sea, and the atmospheric moisture is driven up the sloping side of the mountain, and on being condensed at the summit is discharged in the form of rain or snow on the eastern side over Lakes Glaslyn and Llydaw. The fall of the year gives the wettest months, and it happens that the quantity running from the lakes in spring is averaged up by the snow melting on the sheltered eastern side.

By means of a dam about 100 ft. in length the level of the lake is to be raised 20 ft. The water will be drawn from the lake by means of a tunnel 600 ft. in length at a point 30 ft. below the present level, or 50 ft. below the level when the dams are completed, with the result that there will be sufficient storage for meeting a ninety days' drought. The total fall utilised will be about 1,150 ft., and the total horse-power available, on the basis of a nine hours' working day, is calculated at 8,200. The first installation consists of two steel pipe lines and four 1,000 kw. sets, each consisting of a double tangential waterwheel coupled to a three-phase alternator giving 11,000 volts at forty periods per second.

The company will develop the full horse-power of Lake Llydaw before proceeding further, but they have also acquired a further water-power at Llyn Eigiao, in the Conway Valley, where a fall of 800 ft. is obtainable, and where it is calculated there will be nearly twice as much horse-power available as there is at Llyn Llydaw.

One of the first objects of the North Wales Electric Power Company, as soon as their installation is completed, will be to supply energy for the working of certain light railways which they control in the district. It is, however, in addition, intended to supply electric energy throughout a large area, comprising the whole of the counties of Carnarvon, Merioneth, and Anglesea, and also a portion of the county of Denbigh.

Three-phase currents are to be used, and the transmission lines will be of bare copper wires, 3·24 in. in diameter, carried on insulators triangularly placed on wooden poles. A large proportion of the transmission lines will be carried along the track of the above mentioned light railways. Lines are to be laid to the principal slate quarry districts of Nantlle, Llanberis, Penrhyn, and Festiniog, where a considerable demand for power exists. The distances from the power-station to these places range from six to twelve miles.

LOCH SLOY SCHEME.

The latest water-power electric scheme in the United Kingdom is that of the Scotch Water-Power Syndicate, who have by agreement obtained from Lord Breadalbane and the trustees of the Colquhoun estate of Luss, important water-power concessions. These agreements have been negotiated by Mr. E. Ristori, who, it may be mentioned, was one of the original founders of the Falls of Foyers installation, while the engineering and electrical details have been worked out by Mr. William Vaux Graham and the author.

The first power that it is proposed to develop is one connected with Loch Sloy, which is situated some five miles north of Tarbet, on the side of Ben Vorlich, between Loch Long and Loch Lomond. Loch Sloy, which is situated some 757 ft. above Loch Lomond, which, in turn, is some 26 ft. above the sea level, is fed from a catchment area of about 3,801 acres, which includes one side of Ben Vorlich, which, with its 3,092 ft., is one of the highest mountains in Scotland. The district has the very heavy rainfall of some 74 in. per annum, of which it is calculated that 60 in. will be collectable.

A dam will be constructed at the eastern end of the loch, which will raise the height of the latter by some 60 ft. This will impound some 240,000,000 cubic feet of water, capable, with a calculated net fall of 700 ft. to Loch Lomond, of maintaining some 6,000 e.h.p. on a 25 per cent. load factor for the maximum possible periods of drought, which are calculated at 100 days.

From the loch the water will be taken in the first instance along an open conduit 3,650 yds. in length, which will follow the contour line round Ben Vorlich till a point is reached almost immediately above the position where the power-house will be constructed on the shore of Loch Lomond at a spot called Inveruglas. From the end of this conduit to the power-house the water will be conveyed in steel pipes, the length of the line being about 600 yds., and the height of fall 700 ft.

From the power-house an overhead transmission line is to be constructed in duplicate for the purpose of conveying the electric energy to the industrial areas of the Vale of Leven and the Clyde, which comprise the towns of Dumbarton, Helensburgh, Renton, and Alexandria, and includes shipbuilding yards, engineering and dye works, calico printing works, and factories of various descriptions, many of which have already intimated their desire to be supplied. The transmission line, for which private wayleaves have been obtained throughout, will be overhead on poles, starting from the generating station at Inveruglas, and continuing across country for a distance of twenty-two miles to a sub-station which will be situated at Renton, about midway between Dumbarton and the foot of Loch Lomond, in the centre of the Vale of Leven industrial area. At this sub-station the voltage will be reduced from the 40,000 volts which it is proposed to employ for the long overhead transmission to some 6,000 to 10,000 volts, it being the intention that the distribution from the sub-station to the various works shall be underground.

The following are the efficiencies which it is calculated will be obtained :—

	Full-load efficiency. Per cent.
Open conduit Pipe line Turbines	75
Three-phase generators	94
Step-up transformers	97
High-tension transmission line	93
Step-down transformers	97
Underground distribution (say 6,000 volts average)	95
Total efficiency	58·6

This is on the assumption of the energy being delivered to customers at 6,000 volts. If, as is probable in most instances, it will be delivered at lower voltages, there will be a further transformation, the efficiency of which will be 95 per cent. in the case of transformation in pressure only, and 86 per cent. in the transformation of continuous current, making a total over all efficiencies 55·6 per cent. for three-phase current delivered, and 50·3 per cent. for continuous current delivered.

ADDITIONAL SOURCES OF POWER.

So soon as a market has been found for the total power procurable from Loch Sloy, it is intended to utilise a further water-power—for which the rights have also been obtained—at Ardlui, about two miles further up Loch Lomond. This power is also fed by a small loch with an available fall of 800 ft., the horse-power obtainable being about half that available at Loch Sloy. The Scotch Water-Power Syndicate have, in addition, obtained the rights to still further water-powers on the Breadalbane estate that exist further north, and these will be utilised as soon as the demand for power justifies the capital expense. It is because of these additional powers, which will considerably extend the length of the transmission, that it is proposed from the start to employ so high a pressure as 40,000 volts.

It is estimated that the total cost of the Loch Sloy scheme, including the transmission line and the distribution to the various factories, will not exceed £200,000, which, on a basis of 5,000 h.p. delivered, works out at about £40 per horse-power, everything included. Seeing that many of the existing electric generating stations worked by steam have cost almost this amount for land, buildings, and generating plant, this does not appear to be an excessive figure, and it may be pointed out as an interesting fact that the twenty miles of overhead transmission line only accounts for some £24,000, or about 12 per cent. of the total expenditure. This, coupled with the fact that the calculated loss on the transmission line at full load will only amount to about 7 per cent., and the step-up and step-down losses to another 6 per cent., making 13 per cent. in all, will give some idea of the extent to which the length of the transmission line is but a comparatively unimportant factor in schemes of this description. It may be pointed out further, that the above-mentioned line loss of 7 per cent. is upon the basis of only one of the two duplicate transmission lines being in use. When both are employed the line loss will be reduced to 3½ per cent., and the total transmission loss at full load will be only a little over 10 per cent.

The main transmission will be on the three-phase system over two sets of three copper conductors, each about $\frac{3}{10}$ in. in diameter, the possibility of conveying as much as 5,000 h.p. over a distance as great as twenty-two miles with only 3½ per cent. loss by means of such comparatively small wires being, of course, due to the high pressure employed. Indeed, using pressure as high as 40,000 volts, when it is a matter of transmitting comparatively small amounts of power, as, for instance, the 600 h.p., or thereabouts, that under the present scheme it is expected will be required for the supply of the town of Helensburgh, the interesting point arises that the minimum size of conductor allowable is limited, not by electrical conditions, but by considerations of mechanical strength.

On the main transmission line the conductors will be carried at a minimum height of 40 ft. from the ground, while at all crossings over roads they will be enclosed in a wire cage to meet the Board of Trade requirements for ensuring public safety.

The application of water power in the United Kingdom can, of course, never attain the dimensions that it has already reached in America and elsewhere; still, the above brief account of what is at present being done in Scotland and in Wales shows that there are possibilities even in this old country of which till recently but few were aware.

ECONOMIES OF ELECTRICAL GENERATION BY WATER-POWER.

As regards this, no general rule can, of course, be enunciated, and every case must be dealt with on its merits, according to local circumstances. It is, however, possible to give an indication of what is generally involved, having regard more especially to the fact that with water-power, as a rule, interest on capital plays a much greater part in determining the cost than do labour or upkeep.

Avoiding, on the other hand, small powers where the costs are likely to be abnormally high, and on the other very large powers such as we do not possess in this country, it may be taken generally that interest on capital, depreciation, upkeep, and working expenses in this country will amount to about 12 per cent. on the capital expenditure.

On this basis it is easy to see that to be economically sound the capital involved must not exceed 8½ times the annual price which can be got for the whole of the energy. For instance, if 5,000 h.p. is available for sale, and £6 can be got for each horse-power on the average per annum, the capital involved must not exceed £52 per horse-power, or £260,000 in all.

TECHNICAL PUBLICATIONS.

"THE INDICATOR HANDOOK."

A Practical Manual for Engineers. Part II.: The Indicator Diagram: Its Analysis and Calculation. By Charles N. Pickworth. Second Edition. Whittaker and Co. Emmott and Co., Ltd. (London and Manchester). D. Van Nostrand Company (New York). 3s. net.

The second edition of this useful little manual has an illustrated description of the "Mathot" explosion and pressure recorder. It should be mentioned that the construction and application of the Indicator are fully described in the first part of the work.

"MAGNETISM AND ITS ELEMENTARY MEASUREMENT."

By W. Hibbert, F.I.C., A.M.I.E.E. Longmans, Green and Co. 2s.

This little book, forming part of a larger work on magnetism and electricity, illustrates and describes in detail a magnetic balance, and is intended (*a*) to make the elementary student measure magnetic action under the threefold aspect of "poles," "field," and "flux," and to follow their relationship: (*b*) To raise the idea of "flux" to the chief place, and try to convince the elementary student of the propriety of doing so. The whole subject is made readily intelligible to the student whose interest will be sustained by the numerous experiments and examples which he is called upon to work out for himself.

"PRELIMINARY PRACTICAL MATHEMATICS."

By S. G. Starling, B.Sc., A.R.C.Sc., and F. C. Clarke, B.Sc., A.R.C.Sc. Edward Arnold. 1s. 6d.

Students who are looking out for a simple and reliable introduction to mathematics, and especially those who are called upon to dispense with a tutor, can scarcely do better than make acquaintance with this excellent treatise. It is arranged in such form that the technical student can pass gradually from ordinary arithmetic to such problems in mathematics as are of everyday occurrence.

"LOCI IN MECHANICAL DRAWING."

By Alex. MacLay, B.Sc., C.E., M.I.Mech.E. Part III. Piston Acceleration. The Technical Publishing Company, Ltd. 2s. 6d. net.

The aim in the present part, the author tells us, is to introduce the student of drawing to a class of Loci which are neither geometrical nor mechanical, according to the distinction drawn in Part I., viz., between points supposed to move under purely geometrical conditions on the one hand and point paths in mechanisms on the other. In this section curves of velocity and acceleration are discussed and worked out in connection with piston motion in engine mechanisms of the slider crank order. The work is divided as follows: General: Piston Position. (1) The Double Slider Crank. (2) The Single Slider Crank. (3) The Swinging Block Slider Crank.

"MODERN ELECTRIC PRACTICE."

Edited by Magnus Maclean, M.A., D.Sc. Volume III. The Gresham Publishing Company. 9s. net.

We have already called attention to this freely illustrated series of volumes issued under the editorship of Dr. Magnus Maclean, M.A., and contributed to by some thirty-four specialists. Volume III. has the following contents: Section II. Electric Lighting and Power Distribution. (3) Distribution and Transmission of Electric Energy. (4) Electric Lighting and Wiring. (5) Electric Fittings. (6) Arc Lamps. (7) Incandescent Lamps. Section III. Electric Tramways. (1) The Rails. (2) Rail-bonding. The contributors to this volume are Messrs. W. B. Esson, M.Inst.C.E., M.I.E.E., W. W. Lackie, M.I.E.E., G. Byng and V. Zingler, F. Biliotti, A.I.E.E., C. J. Robertson, M.I.E.E., John R. Wignall, A.M.Inst. C.E., and Victor Watlington.

"A MANUAL OF APPLIED MECHANICS."

By William John Macquorn Rankine, C.E., LL.D., F.R.S. Seventeenth edition, thoroughly revised by W. J. Millar, C.E. Charles Griffin and Co., Ltd. 12s. 6d.

The seventeenth edition of this well-known handbook, comprising the Principles of Statics and Cinematics, and Theory of Structures, Mechanism, and Machines, with numerous diagrams, has just been issued by Messrs. Griffin and Co. It has received various additions and careful revision at the hands of Mr. W. J. Millar, C.E., late Secretary to the Institute of Engineers and Shipbuilders in Scotland.

"ELEMENTARY MENSURATION."

By G. T. Chivers. Longmans, Green and Co. 5s.

Students whose knowledge of mathematics does not extend beyond algebra and trigonometry will find here a treatise which has been designed to meet their particular case. Nine hundred original examples are supplemented by five hundred selected from recent examination papers. The author has included short chapters on the Mensuration of the Conic-Sections; the Theorems of Guldinus; Specific Gravity, with special reference to the weights of solids; the Metric System; and a miscellaneous collection of formulæ.

"AN ELEMENTARY MANUAL ON STEAM AND THE STEAM ENGINE."

Specially arranged for the use of First Year Board of Education, South Kensington, City and Guilds of London Institute, Colonial and other Engineering Students. By Andrew Jamieson, M.Inst.C.E. Tenth Edition, Revised. With numerous Diagrams, Arithmetical Examples, and Examination Questions. Charles Griffin and Co., Ltd. 3s. 6d.

The preliminary notice to the tenth edition calls attention to the fact that all the most important Elementary questions set at the May examinations of the Board of Education, South Kensington, and of the late Science and Art Department for the past dozen years have been allocated to the respective lectures dealing with them.

The 1902 and 1903 Elementary Steam Examinations have been specially printed at the end of the book in Appendix C., along with the "General" Instructions for these examinations, as a further aid to teachers and students. This edition has an attractive coloured folding frontispiece, showing 1903 Lancashire Boiler with Corrugated Flues.

"DYNAMO ATTENDANTS AND THEIR DYNAMOS."

With a section on Motors and Motor Driving. A Practical Book for Practical Men. By Frank Broadbent. Fourth Edition, entirely re-written, and brought up-to-date. Sidney Rentell and Co., Ltd. Dawbarn and Ward, Ltd. 1s. 6d.

We are not surprised to find that this practical manual has already reached a fourth edition, for its 110 octavo pages are packed with just the knowledge which those who have the care of dynamos should have at their finger ends. The work was originally written by Mr. Alfred H. Gibbings, M.I.E.E. The fourth edition has now been entirely re-written, with Mr. Gibbing's permission, by Mr. Frank Broadbent, M.I.E.E. A section has been added dealing with the construction and uses of the various types of motors, including a few pages on single and polyphase induction motors and some practical data on spur gearing. Not the least useful part of this handy book are chapters dealing respectively with faults and breakdowns in dynamos and motors.

"STARTERS AND REGULATORS FOR ELECTRIC MOTORS AND GENERATORS."

Theory, Construction, and Connection. By Rudolf Krause. Translated by C. Kinzbrunner, A.M.I.E., and N. West, A.I.E.E. Harper and Brothers. 4s. 6d. net.

This translation should be welcome both to students and electrical engineers since it deals in an interesting and instructive manner with a subject which has hitherto been somewhat neglected. The author who makes use of numerous diagrams remarkable for their lucidity, treats his subject in the following order: The Conduction of Electric Currents; Circuit-breakers and Circuit-breaking; Theory of Starters. Mechanical Construction of Starters; Calculation of Regulating Resistances for Generators and Motor Construction and Connections of Regulators for Generators and Motors.

"ELECTRICITY AND MATTER."

By J. J. Thomson, D.Sc., LL.D., Ph.D., F.R.S. With Diagrams. Archibald Constable and Co., Ltd. 5s. net.

The first of a series of lectures known as the Mrs. Hepsa Ely Silliman Memorial Lectures. Contents: Representation of the Electric Field by Lines of Force; Electrical and Bound Mass; Effects due to the Acceleration of Faraday Tubes; The Atomic Structure of Electricity; The Constitution of the Atom; Radio-Activity and Radio-Active Substances.

"A TREATISE ON HYDROMECHANICS."

Part I., Hydrostatics. By W. H. Besant, Sc.D., F.R.S., and A. S. Ramsey, M.A. Sixth Edition. George Bell and Sons. 6s.

The sixth edition includes several alterations in the form of excisions and additions. In the chapter on the Stability of Equilibrium of Floating Bodies considerable additions have been made, including a treatment of the subject, based on the principle of energy. In the chapter on Tension of Flexible Surfaces, an alternative method is given for obtaining the general equation connecting the tensions with the curvatures. In the chapter on Capillarity, the laws of capillarity have been deduced by the principle of energy from the assumption of the existence of forces between the molecules. Numerous examples from recent University and College Examination papers have also been inserted.

"PORTLAND CEMENT."

By A. C. Davis. Offices of "The Stone Trades' Journal."

At the present time when our cement market is threatened by foreign invasion these papers by Mr. A. C. Davis, reprinted from "The Stone Trades' Journal," should find a large number of appreciative readers. The author, a well-known cement manufacturer, deals with his topic in a masterly manner, and in discussing the science of cement making, shows that it is not so obscured by technicalities as is generally imagined. The illustrations add to the interest of the work which we recommend to anyone desirous of becoming acquainted with the different methods adopted in this country for the manufacture of Portland Cement.

"POCKET-BOOK OF USEFUL FORMULÆ AND MEMORANDA FOR CIVIL AND MECHANICAL ENGINEERS."

By Sir Guildford L. Molesworth, K.C.I.E., and Henry Bridges Molesworth. With an Electrical Supplement by Walter H. Molesworth. E. and F. N. Spon, Ltd.

This indispensable engineer's *vade mecum* bids fair to achieve the acme of perfection. We have repeatedly submitted it to practical tests, and on each occasion with satisfactory results. In this, the twenty-fifth edition, no pains have been spared to secure the utmost accuracy and completeness. By the substitution of new matter in the place of that which had become obsolete, and the condensation of those portions unnecessarily diffuse, the compilers have been enabled to give a considerable amount of additional matter without increasing the bulk of the volume, which is well bound in limp leather, and of convenient size for carrying in the pocket.

LIST OF BOOKS RECEIVED.

(Mention of a book in these columns does not necessarily perclude review in subsequent issues.)

Mechanics. By John Cox, M.A., F.R.S.C. Cambridge Physical Series. Cambridge University Press, C. J. Clay and Sons. 9s. net.

The Story of the Atlantic Cable. By Charles Bright, F.R.S.E., A.M.Inst.C.E., M.I.E.E. George Newnes, Ltd. 1s.

Fire Tests with Partitions. A Partition formed with Jabez Thompson's Thin White Partition Slabs, and erected by Jabez Thompson, Northwich, Cheshire.

The Committee's Report. Publications of the British Fire Prevention Committee, No. 83. Edited by the Executive. 2s. 6d.

The Fire at the Iroquois Theatre, Chicago, December 30th, 1903. Publications of the British Fire Prevention Committee, No. 81. 3s. 6d.

Gold Assaying. By Joshua H. Phillips, F.I.C., F.C.S., Assoc. Inst. C.E., with numerous Illustrations. Crosby Lockwood and Son. 7s. 6d. net.

An Introduction to Metal Working. By J. C. Pearson. Home and School Library. John Murray. E. P. Ditton and Co. (New York). 2s.

The Management of Electric Tramways and Light Railways. By William R. Bowker, C.E. E. and F. N. Spon, Ltd. 9s. net.

Subject List of Works on the Mineral Industries and Allied Sciences, in the Library of the Patent Office. Published at the Patent Office. Price 6d.

Table of Multiplication, Division, and Proportion for the Ready Calculation of Quantities and Costs, Estimates, Invoice Prices, Interests and Discounts, Weights and Strengths, Wages and Wage Premiums. By Robert H. Smith, M.I.M.E., etc. Archibald Constable and Co., Ltd. 6s. net.

Supplement to Mining Handbook, Highest and Lowest Prices, and Dividends and Crushings of Shares of Mining and Kindred Companies for past Six Years, with Position of the Properties, Capital, etc. Fourth year of issue, 1904. Fredk. C. Mathieson and Sons. 1s.

Designing Ironwork. Second Series. Part IV. General Data on Rolled Steel Joists, Compound Girders, Concrete, and Fire-resisting Materials; followed by Calculations and Working Drawings for a Fireproof Floor. By Henry Adams, M.Inst.C.E., M.I.Mech.E., F.S.I., etc. Published by the author at 60, Queen Victoria Street, E.C. 2s.

Graphs and Imaginaries: An Easy Method of Finding Graphically Imaginary Roots of Quadratic Equations and Imaginary Points of Intersections of various Curves. With illustrations of the principle from Elementary Geometry. By J. G. Hamilton, B.A., and F. Kettle, B.A. Edwin Arnold. 1s. 6d.

Logarithms for Beginners. By Charles N. Pickworth. Whittaker and Co. (London). D. Van Nostrand Company (New York). 1s.

Five-Figure Tables of Mathematical Functions, comprising Tables of Logarithms, Powers of Numbers, Trigonometric, Elliptic, and other Transcendental Functions. By John Borthwick Dale, M.A. Edwin Arnold. 3s. 6d. net.

La Télégraphie sans Fil, L'Œuvre de Marconi, Traduit du "Scientific American" de New York. By Emile Guarini. Ramlot Frères et Sœurs, Bruxelles. Fr. 2.50.

L'Electricité dans les Mines en Europe. Traduit de "The Engineering Magazine" by Emile Guarini. Ramlot Frères et Sœurs, Bruxelles. Fr. 5.

L'Etat Actuel de l'Electroculture." By M. E. Guarini. Ramlot Frères et Sœurs, Bruxelles. Fr. 1.

Mathieson's Highest and Lowest Prices. Uniform with "Mathieson's Provincial Highest and Lowest" and "Six Months' Prices and Dates." 1904 issue—Nineteenth as "Complete Record." Fredk. C. Mathieson and Sons. 2s. 6d.

Fire Tests with Floors: A Floor of Karri Wood by Millar's Karri and Jarrah Forests (1902), Ltd. Particulars of Experimental Test. Edited by Edwin O. Sachs. Publications of the British Fire Prevention Committee, No. 79. 2s. 6d.

Pamphlets: Electricity for Small Hospitals. By W. Noble Twelvetrees, A.M.I.E.E., M.I.Mech.E. Comparison of Different Types of Calorimeter. By J. S. S. Brame and Wallace A. Cowan.

From Messrs. Cassell and Co.:—

Leather Working. A "Work" Handbook. With numerous Engravings and Diagrams. Edited by Paul N. Hasluck. 1s.

Harness Making. A "Work" Handbook. With numerous Engravings and Diagrams. Edited by Paul N. Hasluck. 1s.

Timber. Growth and Structure, Felling, Converting, and Buying, Measuring, Seasoning, Properties and Defects, Preservation, Varieties. With numerous Illustrations. Edited by Paul N. Hasluck. One of the "Mechanics' Manuals." 6d. net.

Builders' Hoisting Machinery. Simple Lifting Tackle, Winches, Crabs, Cranes, Travellers, Motive Power for Hoisting Machinery. With numerous illustrations. Edited by Paul N. Hasluck. One of the "Mechanics' Manuals." 6d. net.

Single Entry Book-keeping for Builders. Account Books, Commercial Terms, Time Sheets and Pay Sheets, Wages, Order, Transfer, Cartage, Day, Jobbing, Prime Cost and Cash Books, Balance Sheets, Contracts, System for Small Builders, Foreman's Books. With nearly sixty examples. Edited by Paul N. Hasluck. One of the "Mechanics' Manuals." 6d. net.

OUR DIARY.

August.

22nd.—The Liverpool Chamber of Commerce denounce the action of Russian cruisers in detaining and destroying British shipping as being highly detrimental to British commerce.

23rd.—The Engineering Standards Committee issue a report relating to British standard tables of copper conductors.

25th.—Conclusion of the summer meeting of the British Association.—Launch of the *Victorian* at Belfast.—About a hundred civil engineers leave Euston for St. Louis Exhibition.

26th.—Discovery of a gold mine capable of producing two to three millions sterling annually, in the Rikuzen province, Japan.—Adjournment of the Johannesburg Shipping Commission.—The value of the Transvaal imports for the first half-year of 1904 amounted to £6,842,042, as compared with £11,415,044 in the corresponding period of 1903. The Customs receipts for the first six months of the present year amounted to £852,427, against £1,138,352 in the corresponding period of 1903.

27th.—A special conference of miners assemble at Dalkeith to discuss the intimation of the Scottish coalmaster, that the minimum wage north of the Tweed must be lowered.

28th.—The Government of Japan issues a proclamation entirely reserving the recently-discovered goldfields.

29th.—A conference of miners' delegates meet at Cardiff to consider the policy to be pursued in reference to the attitude of the Scottish coalmaster towards the minimum wage in Scotland.

30th.—Issue of the annual statistical tables relating to coal production and trade in the British Empire and the principal foreign countries in 1903.

31st.—The revenue of New South Wales for the past two months amounted to £1,704,890, as compared with £1,753,679 in the corresponding period of last year.

September.

1st.—Opening of the Midland Railway's new cross-channel services between Heysham, Belfast and Dublin.—Termination of the Tyneside boilermakers' strike.—Opening of a conference of the Miners' Federation of Great Britain to consider the Scottish wages question.

2nd.—Sir W. H. White and 100 members of the Institute of Civil Engineers embark at Liverpool for the United States.

4th.—Openings of the Trades Union Congress at Leeds. The "Times" reports the discovery of a gold mine at Khabarovka, Eastern Siberia.

5th.—Professor Turner delivers an introductory lecture at the opening of the Birmingham University's new metallurgical smelting house, Bournbrook.—The Employers' Federation on the north-east coast give notice of a reduction of 2s. per week on time and 5 per cent. on piece rates.

7th.—Signing of the treaty between Great Britain and Tibet.

9th.—The ordinary and extraordinary revenue of the Colony for the year ended with June last amounted to £5,323,341, and the expenditure to £4,598,203.—Sir F. Hopwood's report on railway servants' hours of labour issued as a parliamentary paper.

10th.—The Antarctic exploration ship, *Discovery*, arrives at Portsmouth after her cruise of over three years in South Polar regions.—Conclusion of the Trades Union Congress at Leeds.—Delegates of the employees of the Midland iron trade meeting at Wednesbury decide to give notice to terminate the present sliding scale agreement with the employers.—The Board of Trade refuses to sanction the construction of a dockyard at Lot's Eyot, Kew.—Launch of the steel screw steamer, *Potaro*, at Belfast.—Mr. Lloyd-George, M.P., opens a new pier at Menai Bridge, Anglesey.

12th.—Members of the Association des Ingénieurs Sortis de l'Ecole de Liége visit London.—Launch of the new torpedo-boat destroyer, *Boyne*, at Hebburn.

13th.—The L.C.C. sanction further loans by the Marylebone Borough Council to the amount of £433,800 in connection with the electric lighting of the borough.—The Iron and Steel Institute entertain at the Hotel Cecil a party of members of the Liége Association of Engineers.

14th.—Institution of Mining Engineers meet at Birmingham.—It is reported that operations conducted by the Electrical Ore Finding Company, have been successful in locating Hematite ore near Barrow.

15th.—The Antarctic exploration ship *Discovery* arrives at the East Indian Dock.—The Government of Natal decides upon the construction of a railway from Bethlehem to Kroonstad.—Conclusion of the Annual Conference of the Institute of British Carriage Manufacturers.

16th.—Lord Stanley of Alderley inaugurates the Holyhead Electric Light Works.

NOTES.

The A. B. P. Accumulator Company, Ltd., of Stockton-on-Tees, are shipping an order for 230 cells of their standard S4–11 plate type to Calcutta.

Professor W. E. Dalby has been appointed Professor of Civil and Mechanical Engineering at the City and Guilds Central Technical College, South Kensington.

United States Metallic Packing is to be fitted to all the rods on the main and auxiliary engine of the new Cunard steamer, *Caronia*, recently launched at Clydebank.

During the month the electric lighting undertaking at Holyhead, was inaugurated, the light being switched on by Lord Stanley of Alderley. This is a combined destructor and lighting installation, the destructor being on Messrs. Meldrum Bros., Ltd, of Manchester, patent regenerative system, with continuous furnace chamber. The whole scheme has been carried out to the designs and specifications of Mr. Price F. White of Bangor, consulting engineer to the Holyhead Council.

Messrs. W. T. Glover and Co., Ltd., have been awarded a contract in connection with electric light and power cables, for the Johannesburg municipality, amounting to considerably over £100,000. This includes the supply and laying of their Diatrine paper insulated lead covered, Diatrine paper leadless, and vulcanised rubber cables, the high tension mains being for 3,000 volts working pressure. The whole of these, together with joint boxes and accessories, will be manufactured at the Trafford Park Works of the Company.

NEW CATALOGUES AND TRADE PUBLICATIONS.

The Oliver Typewriter Company, Ltd., of 75, Queen Victoria Street, E.C., send us an attractive booklet printed in two colours and enumerating the advantages of the Oliver Typewriter (No. 3 model).

From Mr. Percy Pitman, Hydraulic Engineer, of Bosbury, Ledbury, Herefordshire, we have received new lists of Pelton Water Wheel Motors, together with notification of change of address from Halifax as above.

The British Westinghouse Electric and Manufacturing Company's (Ltd.) special publication B 7028, "A Million Horse-power," gives a list of the more important electrical installations in the United Kingdom and its Colonies, carried out by the Company; we note from the introduction that only installations of 100 horse-power and over have been included. The booklet is well printed in two colours on art paper, and contains numerous illustratious.

W. C. Holmes and Co., Tunbridge Foundry and Whitestone Ironworks, Huddersfield, forward two well-printed and illustrated circulars dealing with the following specialities: Patent Pelouze and Audouin tar extractor with automatic by-pass valve; patent "new" scrubber washer; dry-faced purifiers with patent rubber jointing; water-tube condensers; double-faced "western" valves; self-sealing mouthpieces with automatic catch; complete coal-gas installations; bridges, girders, roofs, tanks; gasholders, etc.

The Lucal Light and Heating Company, Ltd., of 65, West Regent Street, Glasgow, advise us that they have just had their Lucal Liquid Fuel Burner tested by Professor Watkinson, whose report, together with much additional interesting information, is incorporated in an illustrated circular. The report states that, considering the poor quality of the oil used for the tests and the temporary nature of the arrangements, the results obtained were exceedingly satisfactory. Combustion appeared to be practically perfect and almost smokeless.

John Lang and Sons, of Johnstone, near Glasgow, forward us a copy of the latest edition of their profusely illustrated lathe catalogue. Special attention is drawn to Lang's Patent Variable Speed Drive which is now fitted to all the sizes of lathes manufactured by the firm. Surfacing and boring lathes fitted with this drive are so arranged that the revolutions of spindle automatically increase as the diameter being turned becomes smaller, thus keeping the cutting speed of tool practically constant. We recommend all who are interested in lathes to get a copy of this catalogue.

Meldrum Bros., Ltd., Timperley, near Manchester, forward an important paper by Mr. W. Francis Goodrich, on "The Disposal of Institutional and Trade Waste," read at a meeting of the Royal Institutute of Public Health. The paper is freely illustrated and will repay attention on the part of those called upon to deal with trade waste. Five of the illustrations are devoted to destructors erected by the Company for the Metropolitan Asylums Board at the Northern, Western, Park, and Joyce Green Hospitals. Another interesting figure shows their portable destructor. This is especially useful for military purposes and is capable of destroying five tons of refuse per day.

Those of our readers who are interested in photography should send to Messrs. Marion and Co. Ltd., of 22 and 23, Soho Square, London, W., for a copy of their exhaustive catalogue of photographic apparatus and materials. Some useful hints to amateurs are incorporated in the 369 pages of this book which we note cancels all previous issues. A "supplement to Marion's photographic catalogue, May 1904," deals more fully with a new series of Magazine Plate cameras, constructed by the firm and called the "Star" cameras. We have also received leaflets describing three new dark-room lamps, and a new form of print washer known as the "Alexandra."

Ferranti, Ltd., Hollinwood, Lancashire. From this firm we have received copies of their price lists and catalogues Nos. 1, 2 and 3 (June 1904), dealing respectively with Reverse Current Relay for Continuous Current circuits, Moving-coil instruments, 8-in. round type and shunts for Moving-coil ammeters.

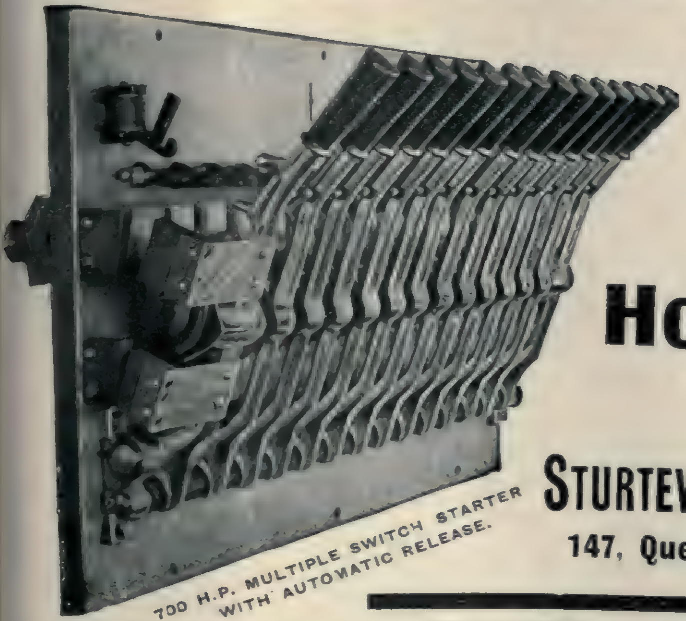
They also forward price lists describing and illustrating their Current Transformers (class AA), for integrating wattmeters (catalogue No. 4), Alternating-current switchboard integrating wattmeters (No. 5), and Potential Transformers for wattmeters, voltmeters, synchronisers, relays etc. (No. 6); also list No. 12, of their indicating wattmeter for single and multiphase alternating current circuits, 8-in. round type, in cast-iron case.

From W. H. Bailey and Co., Ltd., Albion Works, Salford, Manchester, we have have received a copy of their latest catalogue dealing with Compressors and Vacuum Pumps, which the firm are now making under the "Köster" Patents, having secured the sole manufacturing right, for the United Kingdom. In the early portion of the catalogue there is given a list of some of the many uses to which the Compressors and Vacuum Pumps may be put; this is followed by a brief description of the machines, and a few pages are devoted to the advantages to be obtained by Multiple Compression, the tables giving particulars of the firm's standard sizes. The catalogue is printed on art paper and each page has an artistic border in biscuit colour, which shade also forms the predominating colour of the cover. Numerous full-page half-tone blocks are included, as well as a number of diagrams and smaller illustrations.

The British Thomson-Houston Company's (Ltd.) Price List No. 84, of Fusible Cut-outs and Fuses, supersedes Price List No. 65, and comprises the following: Type AD Open Fuse Blocks for alternating and continuous current circuits up to 300 volts; Type MSd Switch Fuses for alternating and continuous current circuits up to 750 volts; Fusible Cut-outs with the Magnetic Blow-out for continuous current circuits up to 600 volts; Expulsion Type Fusible Cut-outs for high potential alternating current circuits; Fusible Cut-outs for enclosed Fuses for alternating and continuous current curcuits up to 500 volts; Insulator Type Primary Fusible Cut-outs, for high potential alternating current circuits up to 2,500 volts; Type BT Primary Fusible Cut-out for high potential alternating current circuits up to 7,000 volts; Tube-Expulsion Fusible Cut-out for extra high potential alternating current circuits up to 10,000 volts; Miscellaneous Fuses; and Standard Fuse Wire.

From the same firm we have received pamphlets No. 169, (Single-phase Induction Motors), No. 170 (electrically operated cranes), and No. 171 (the B. T. H. Meridian Lamp).

MULTIPLE SWITCH STARTER



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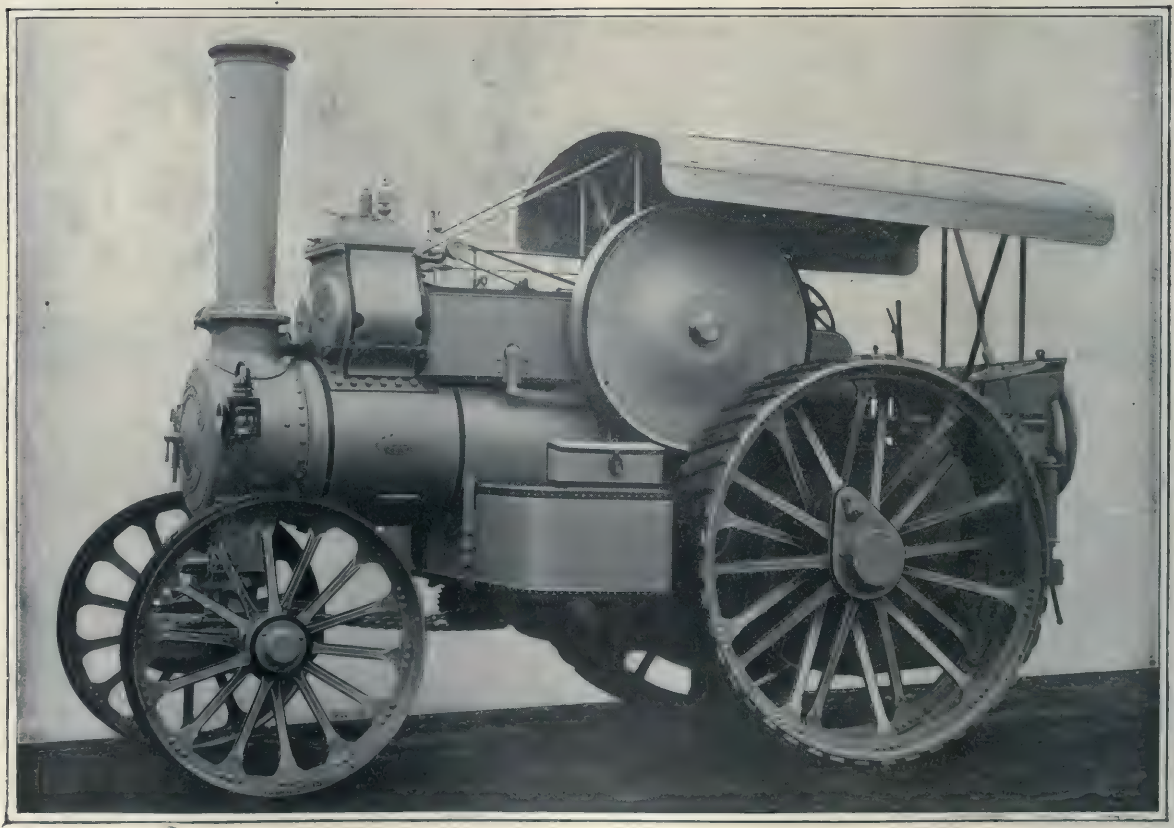

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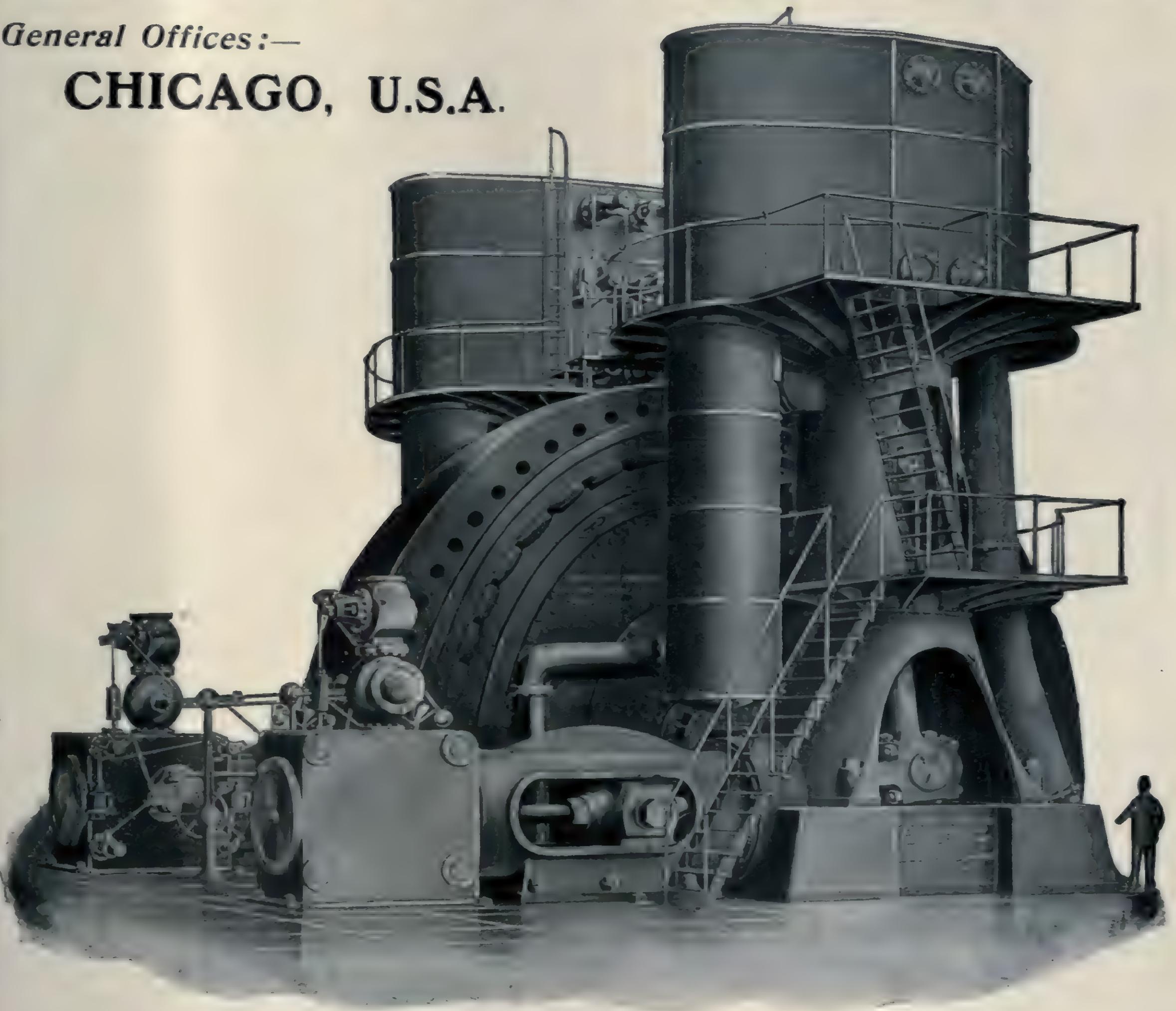

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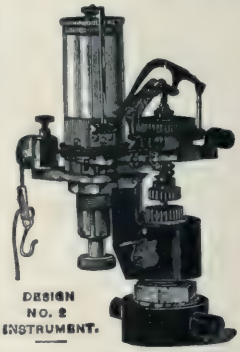

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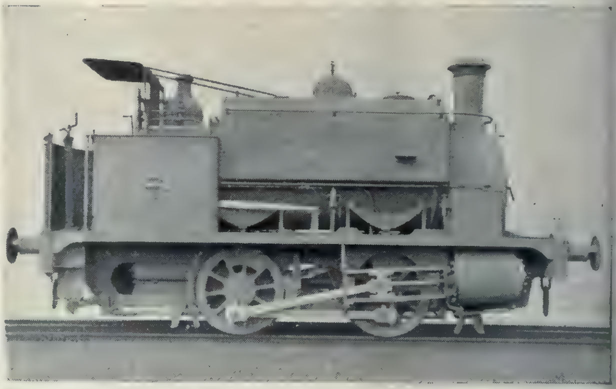

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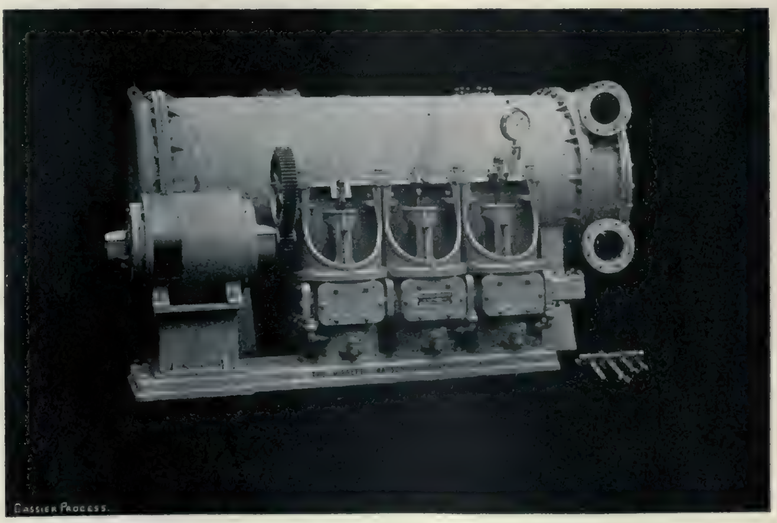

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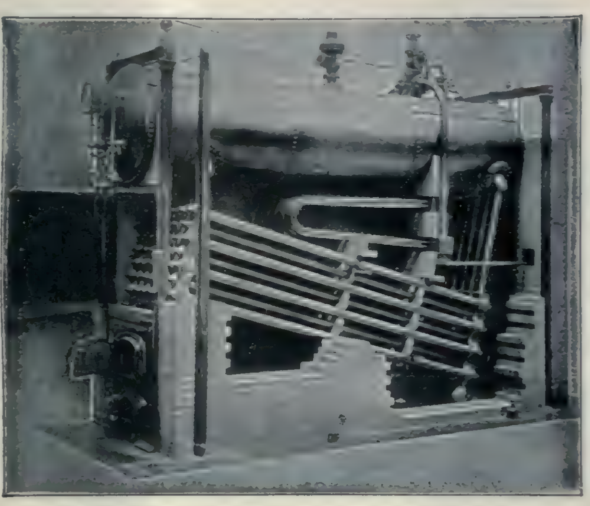

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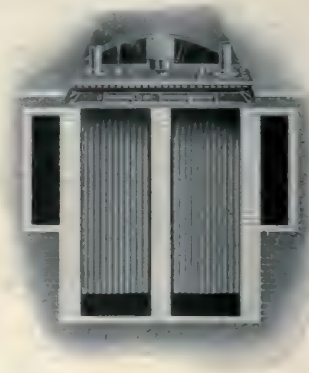

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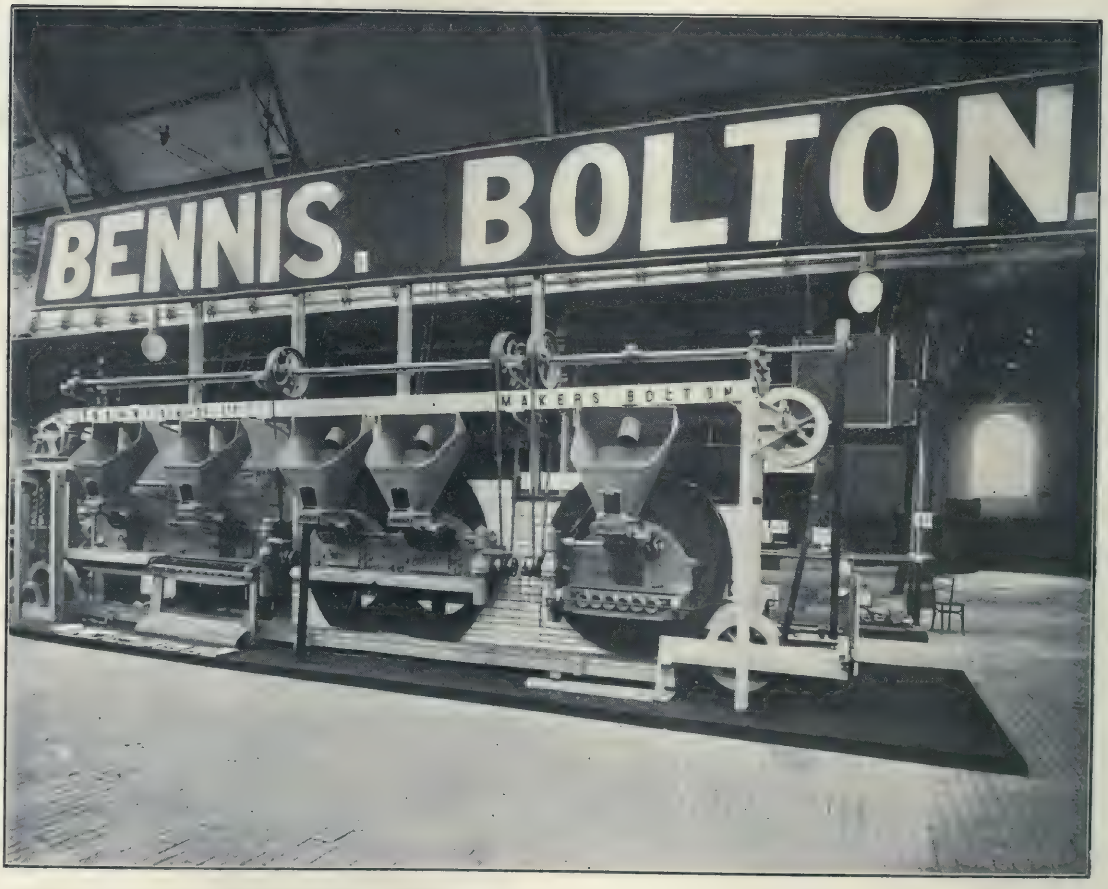

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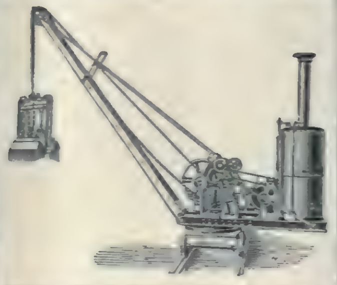

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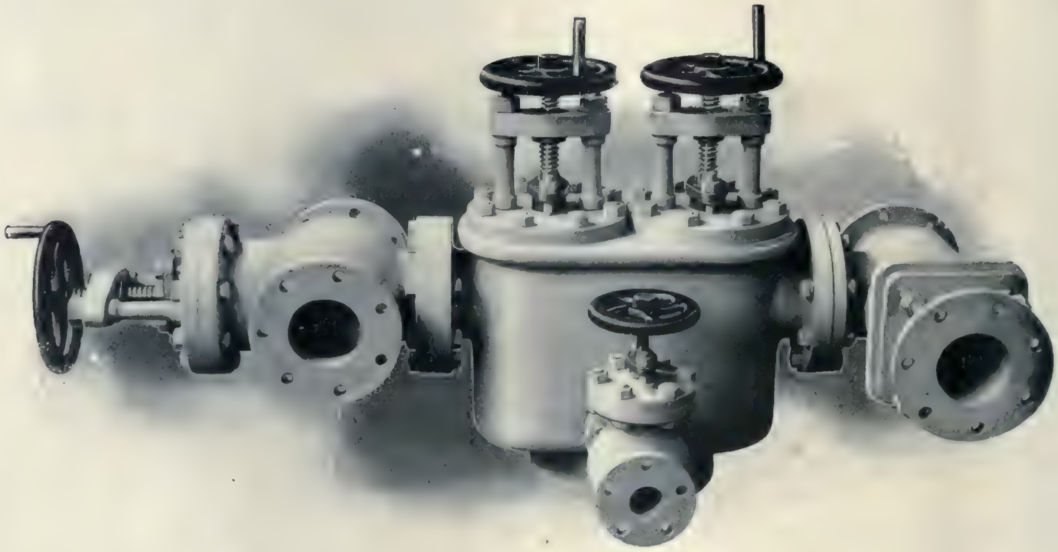

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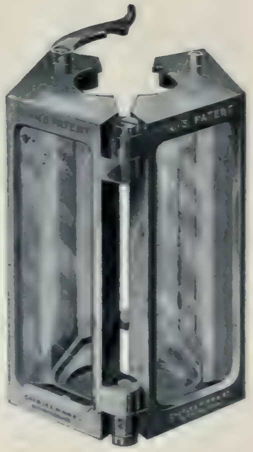

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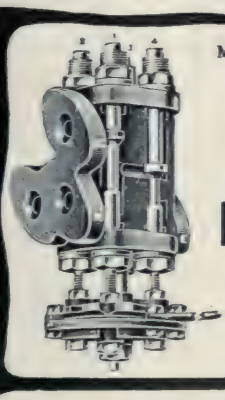

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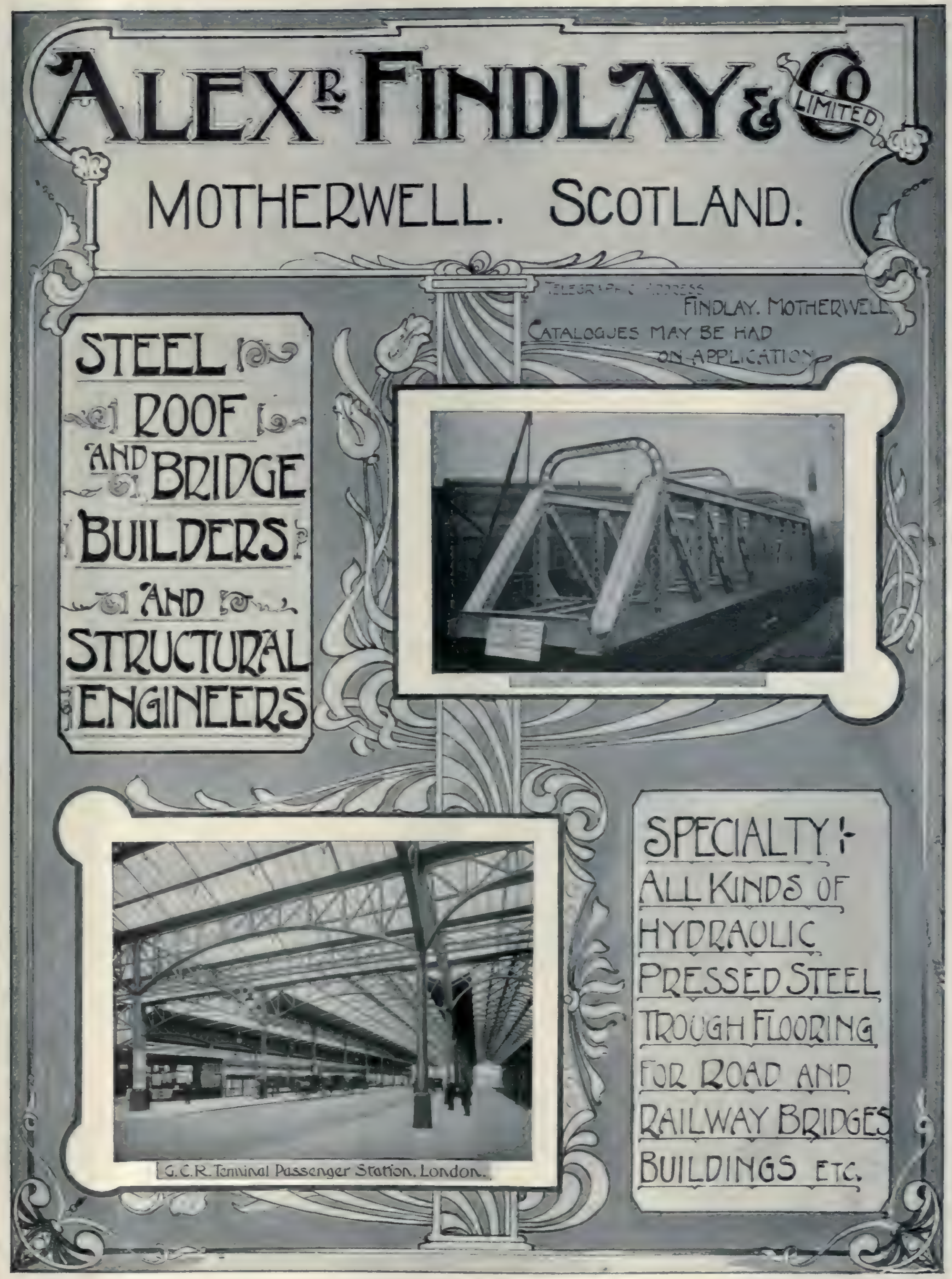

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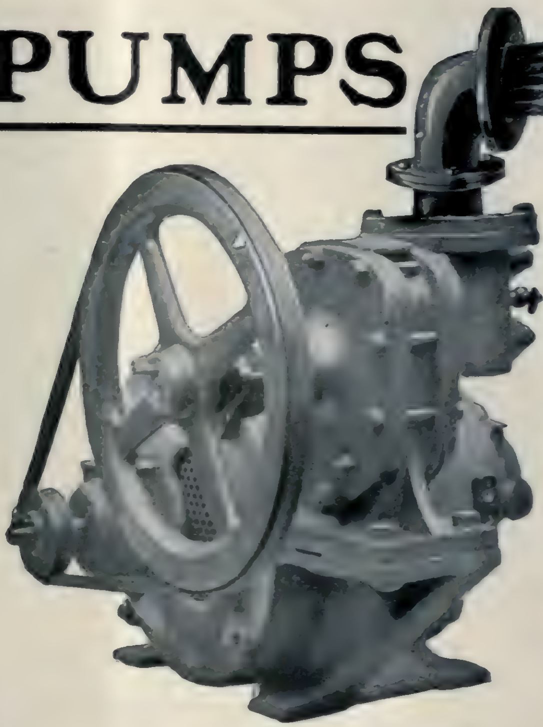

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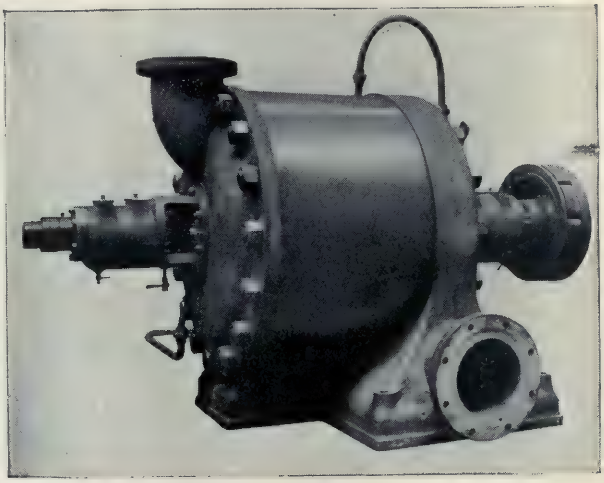

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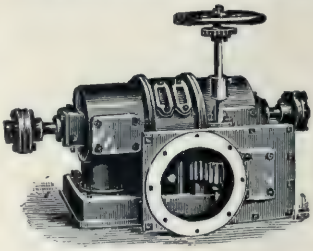

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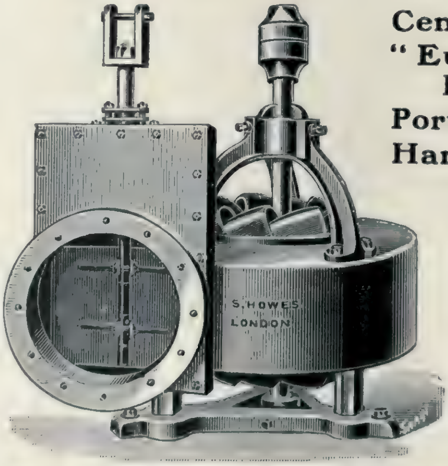

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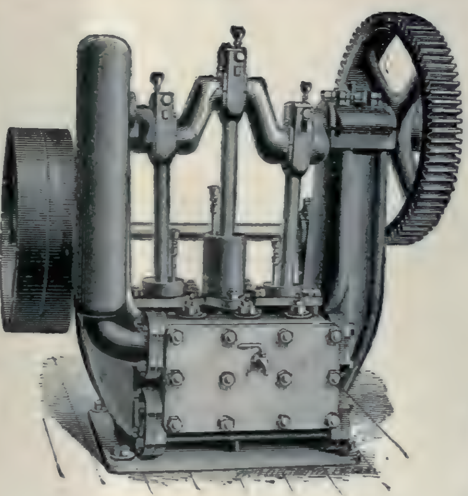

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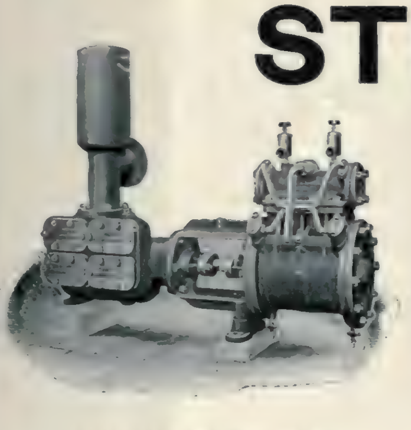

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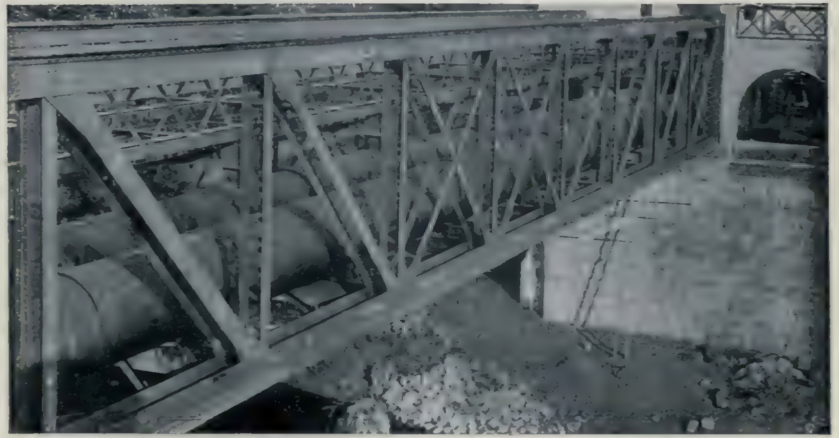

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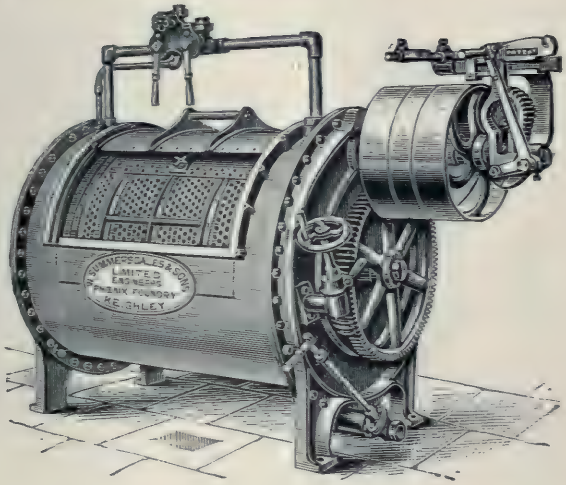

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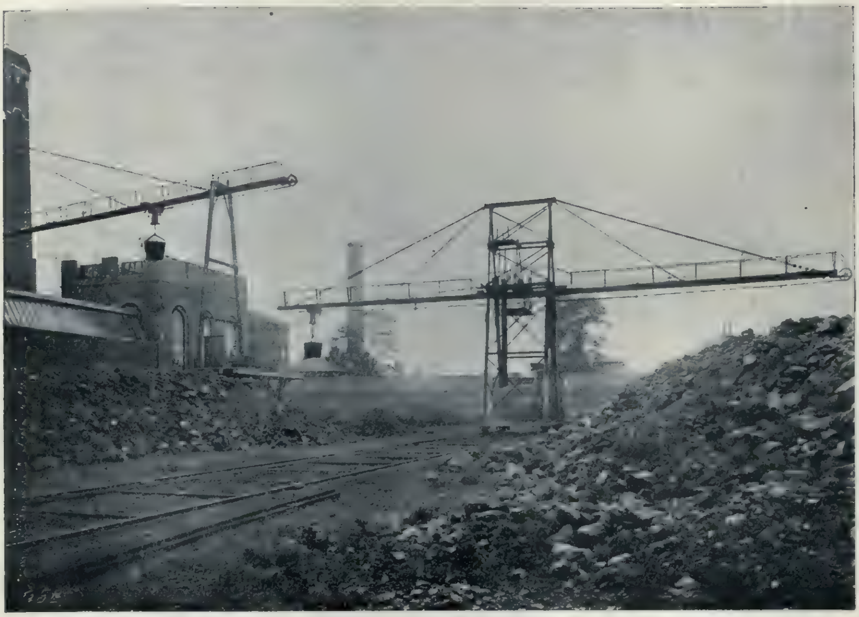

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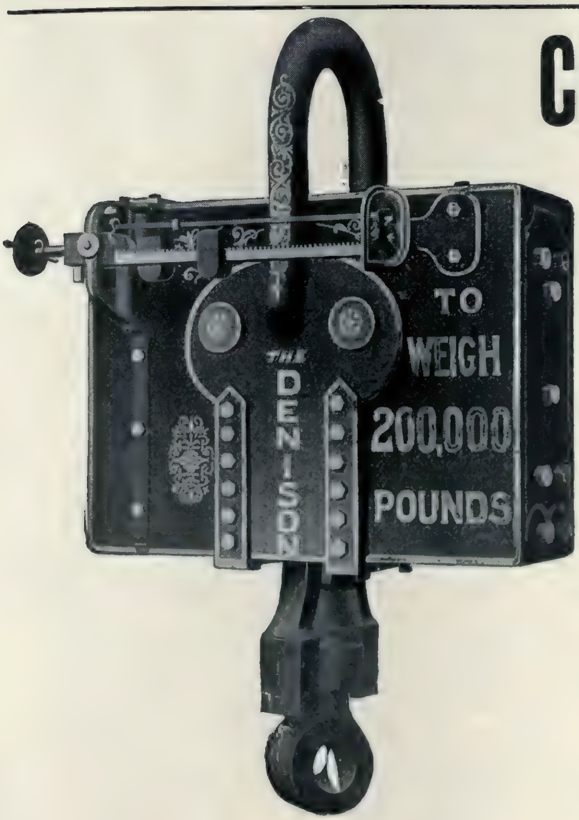

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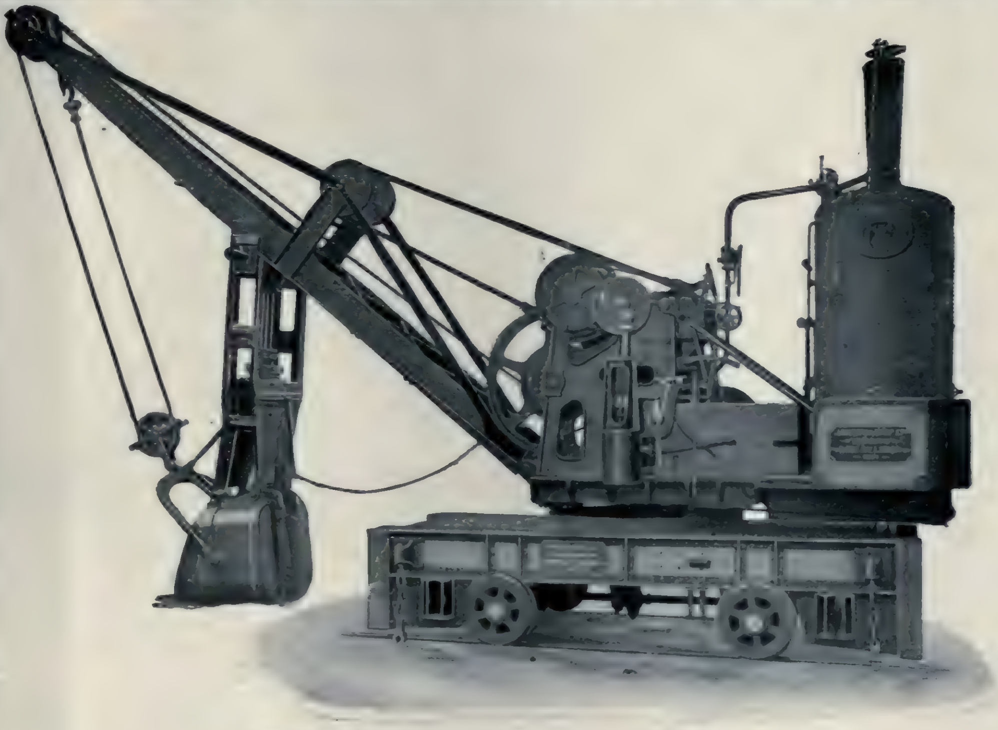

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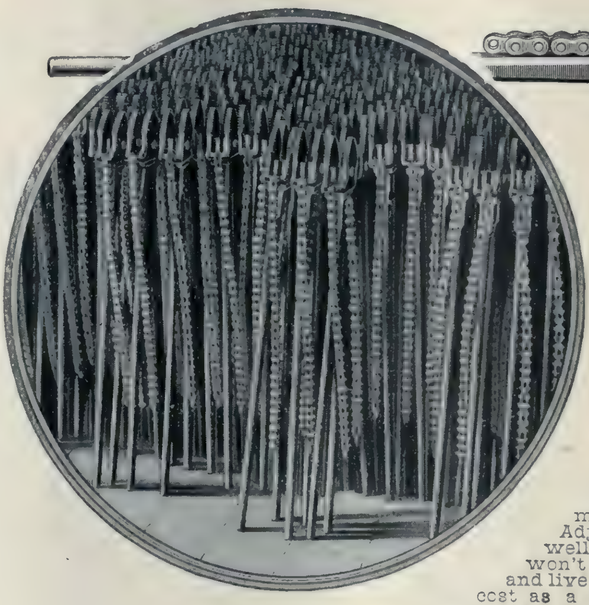

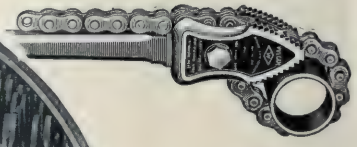

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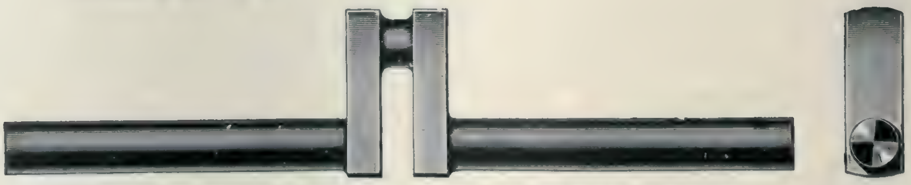

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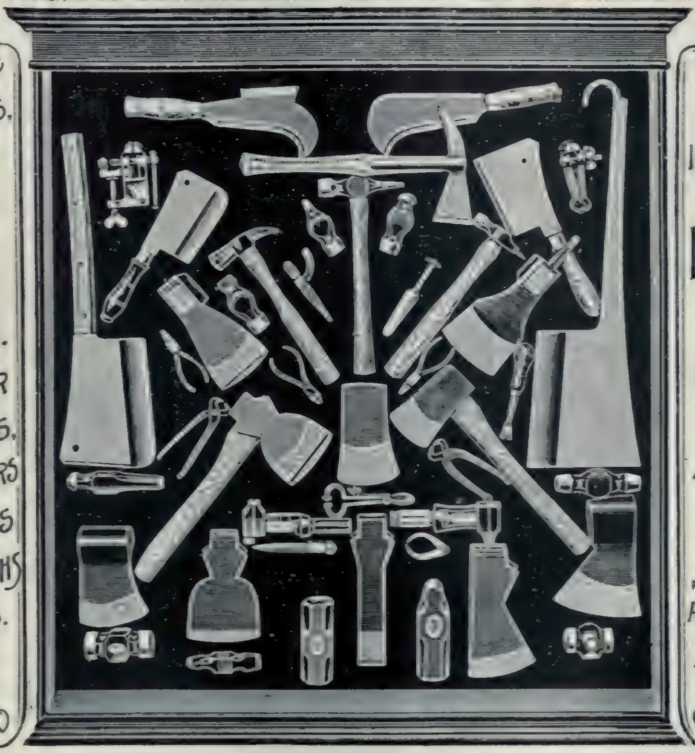

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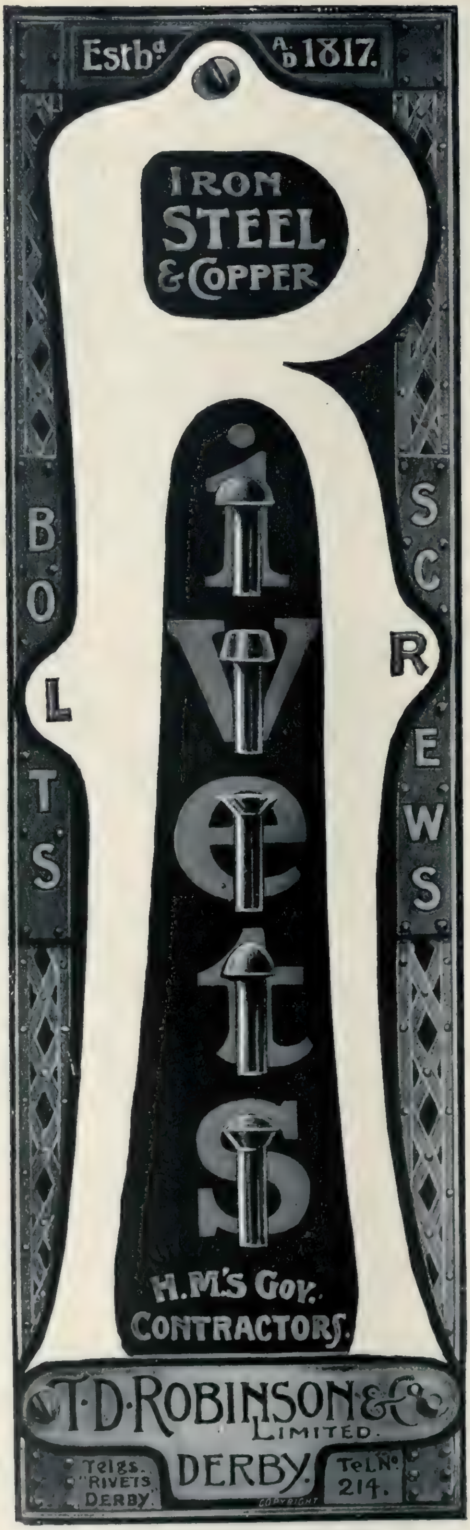

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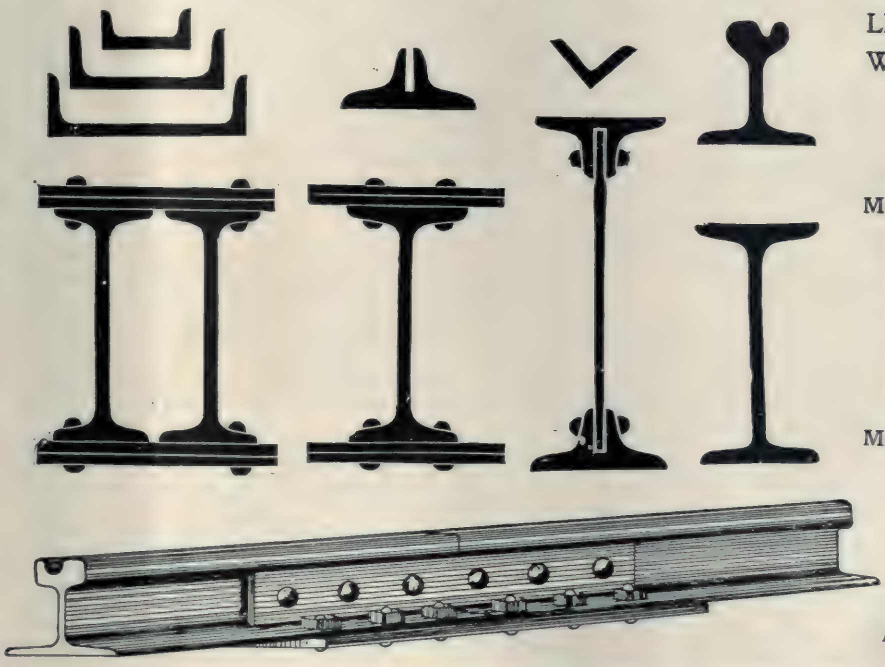

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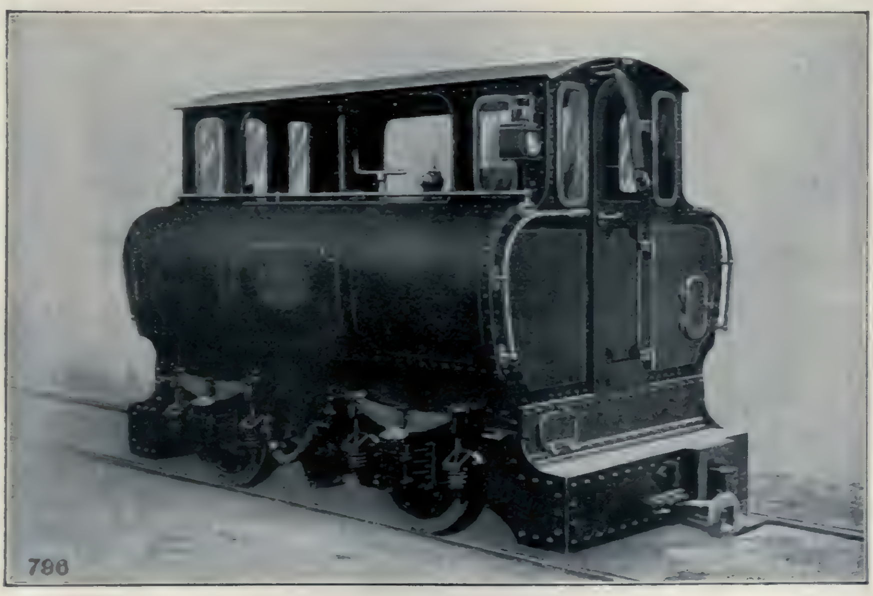

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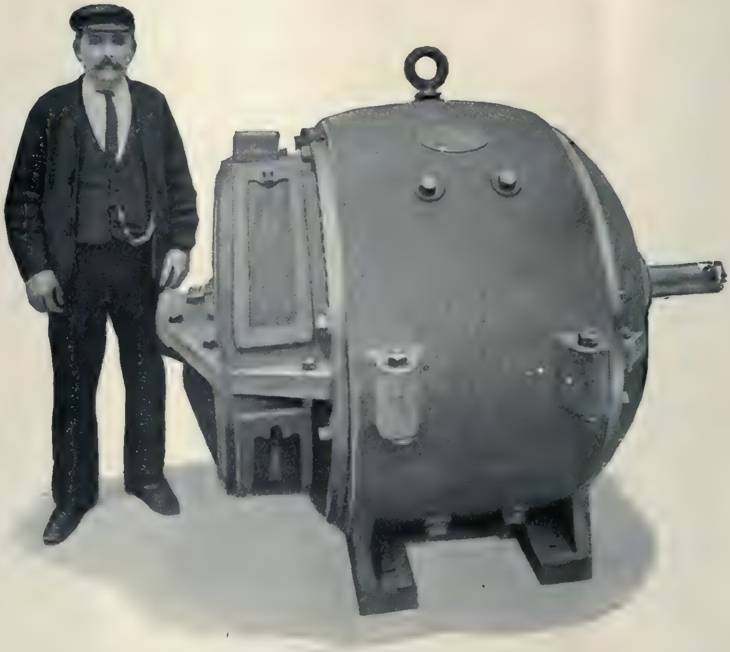

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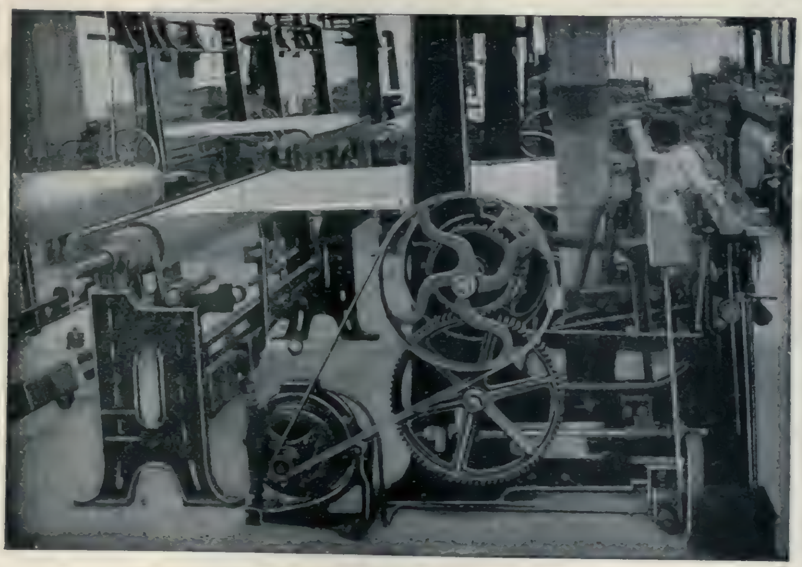

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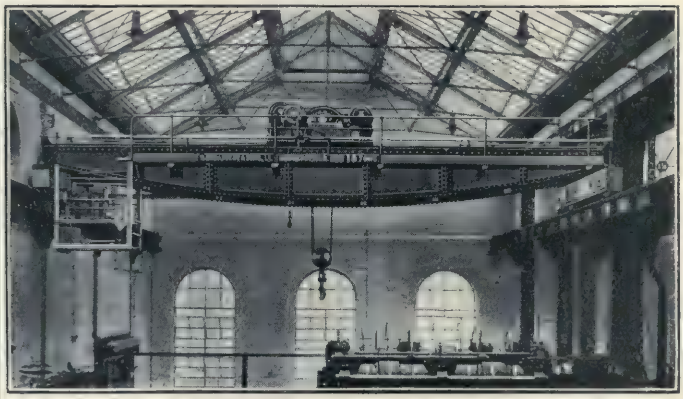

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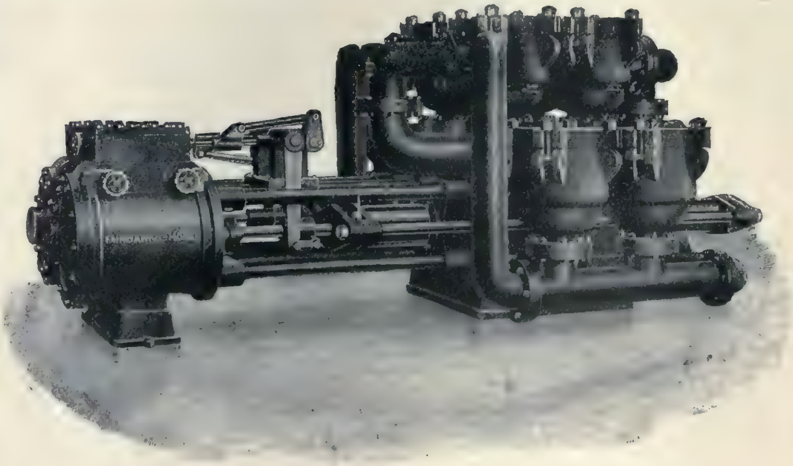

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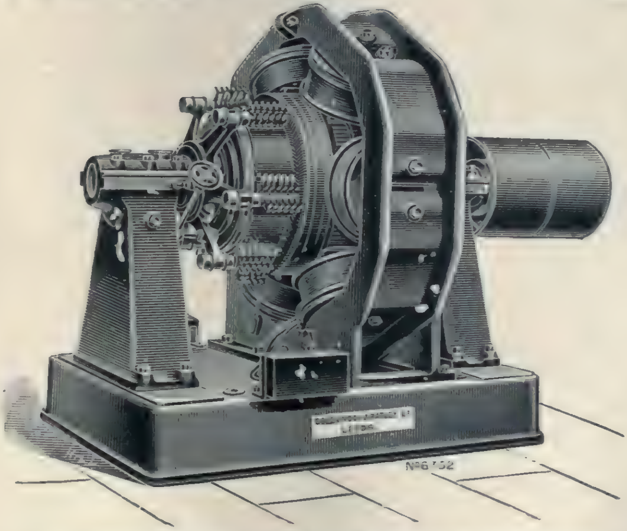

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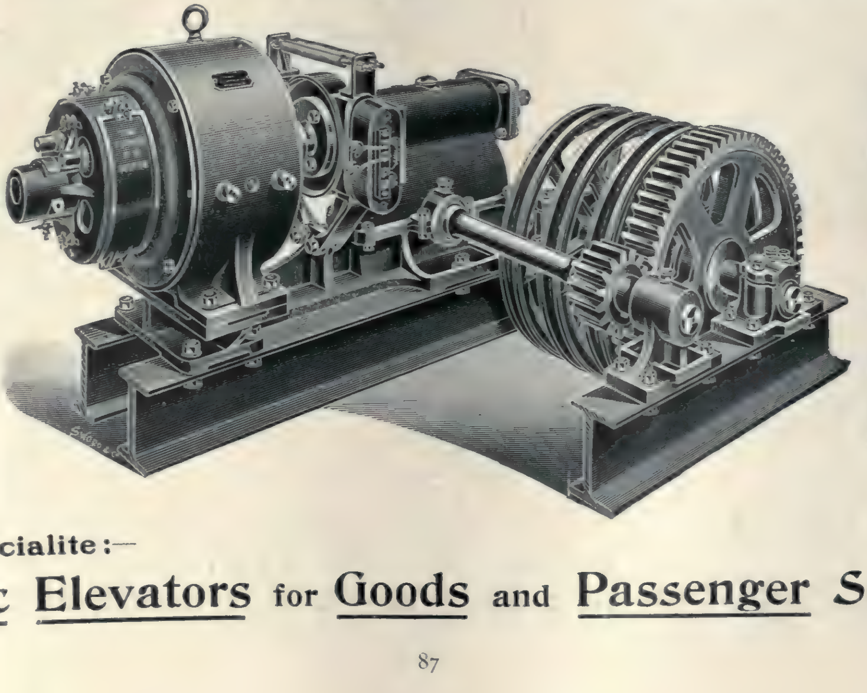

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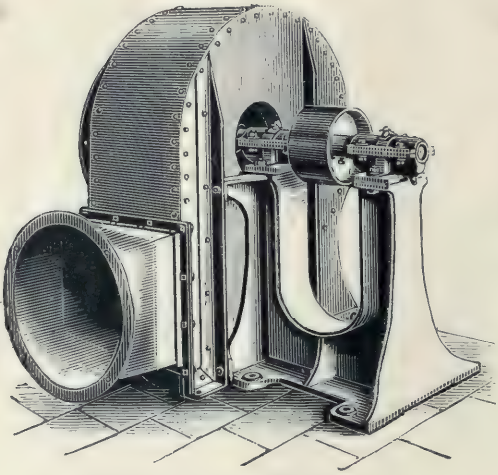

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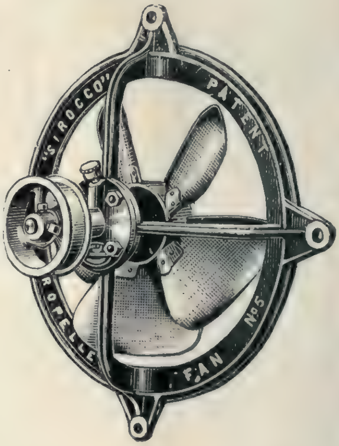

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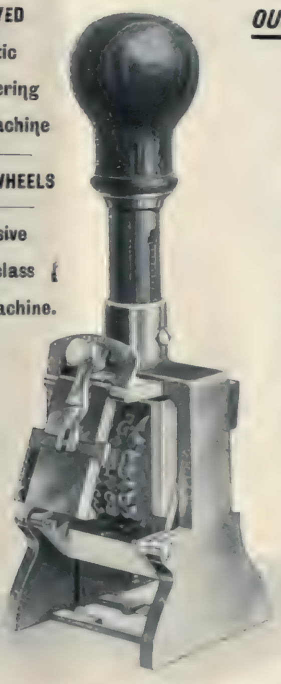

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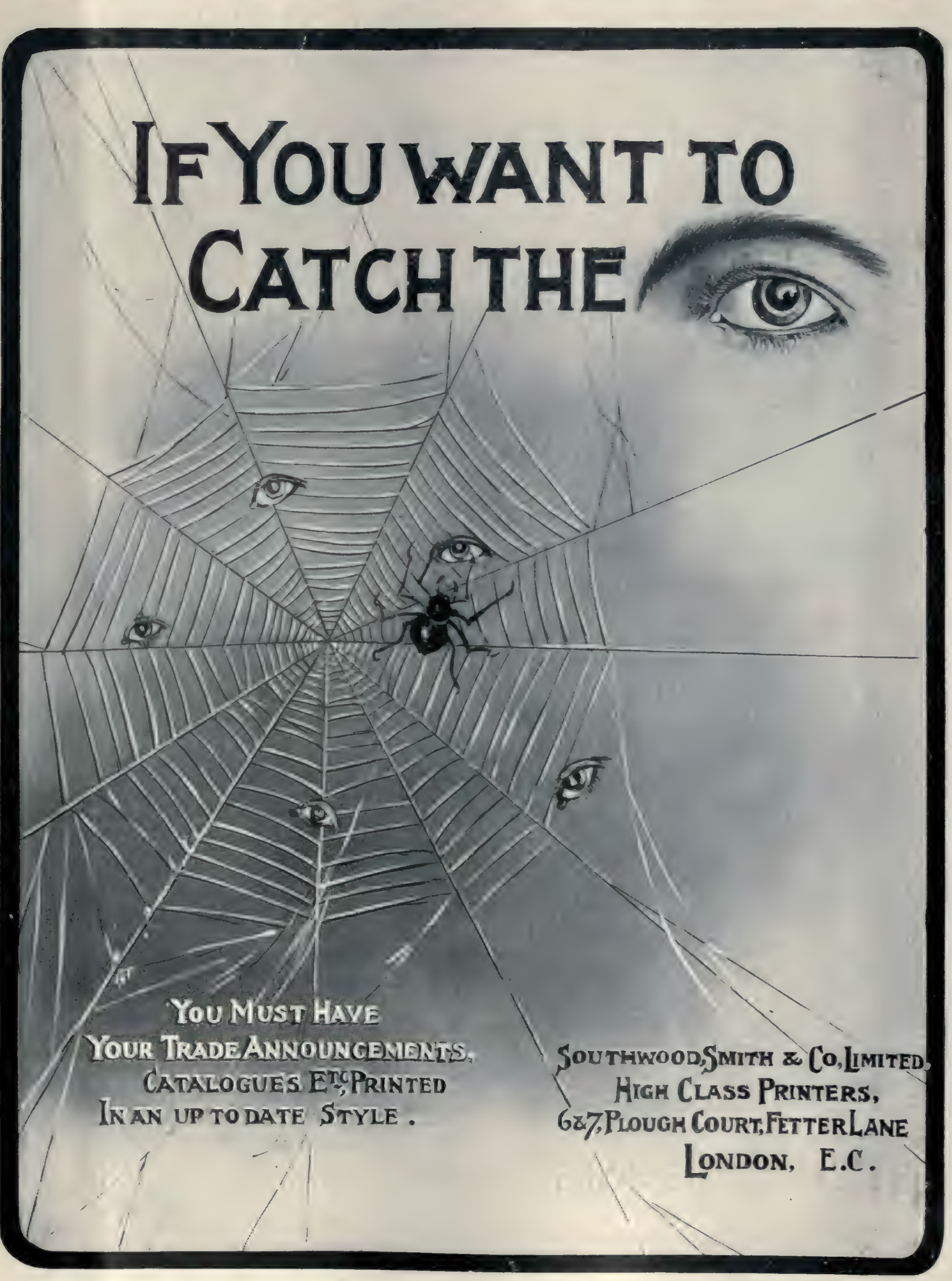

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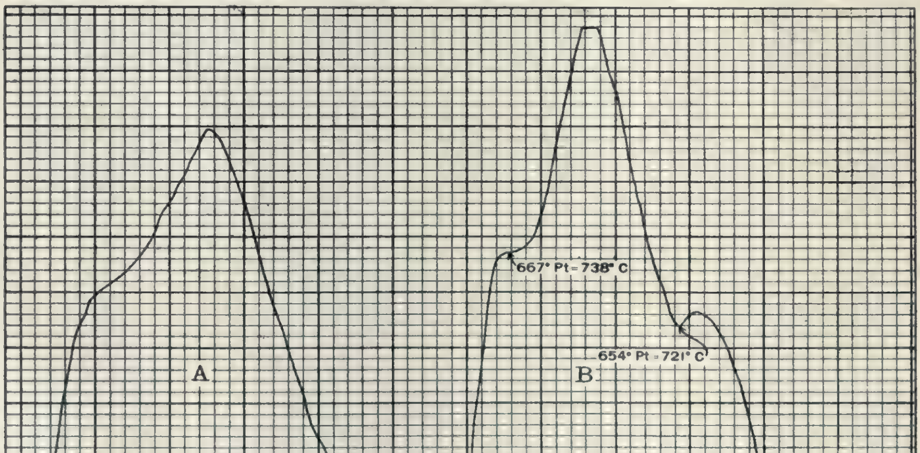

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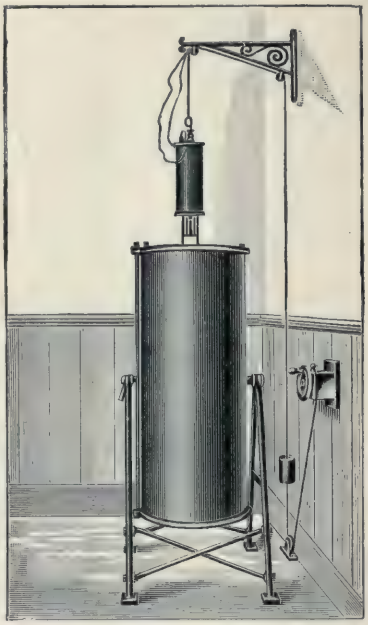

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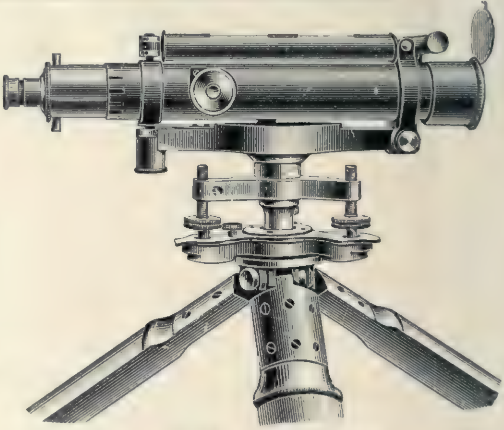

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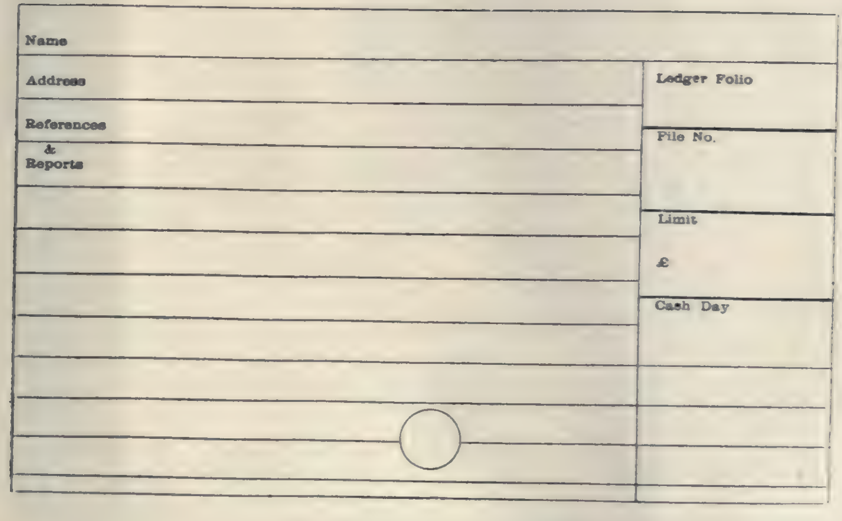

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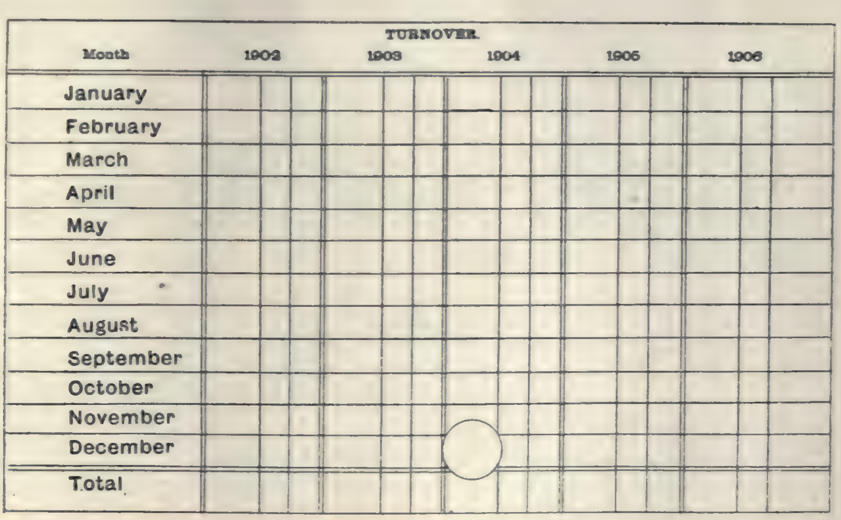

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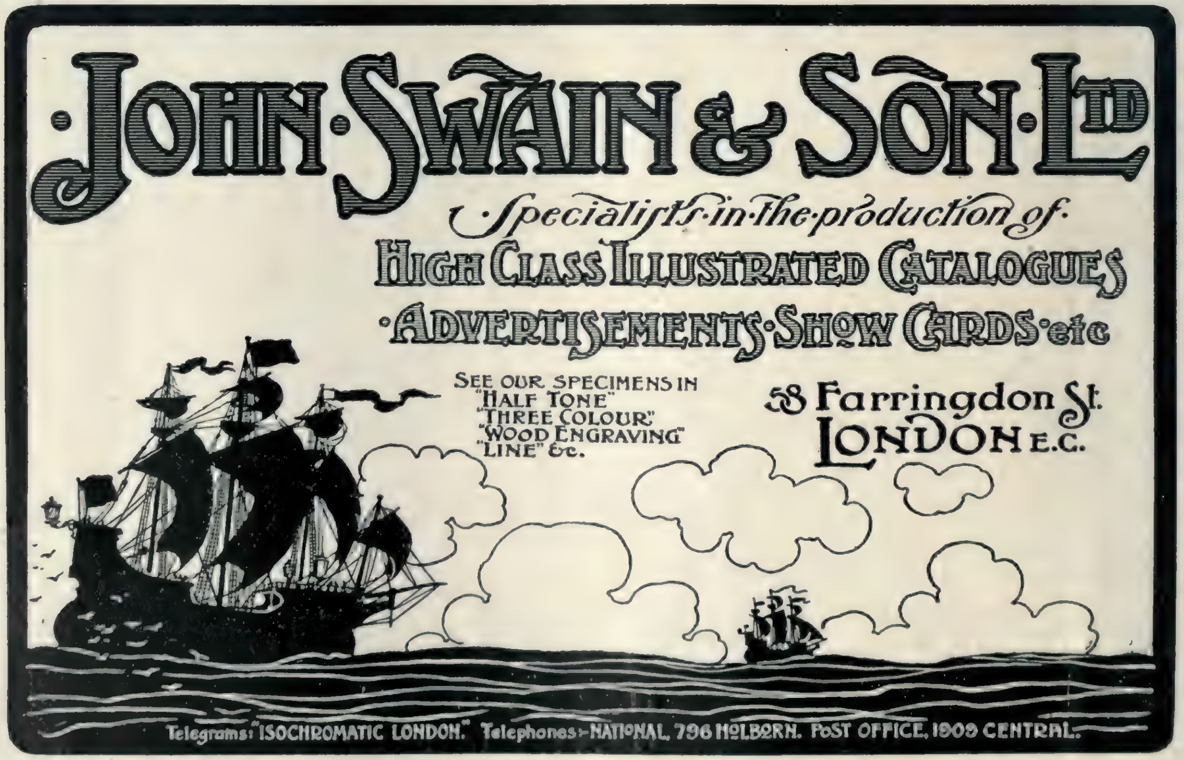

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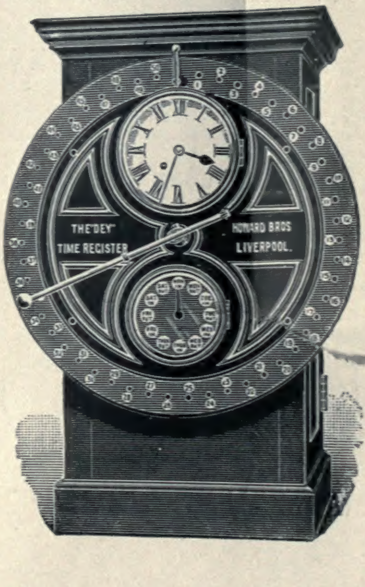

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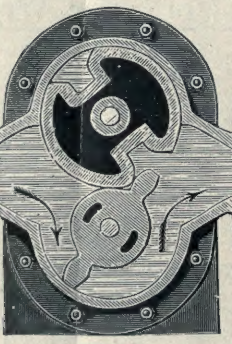

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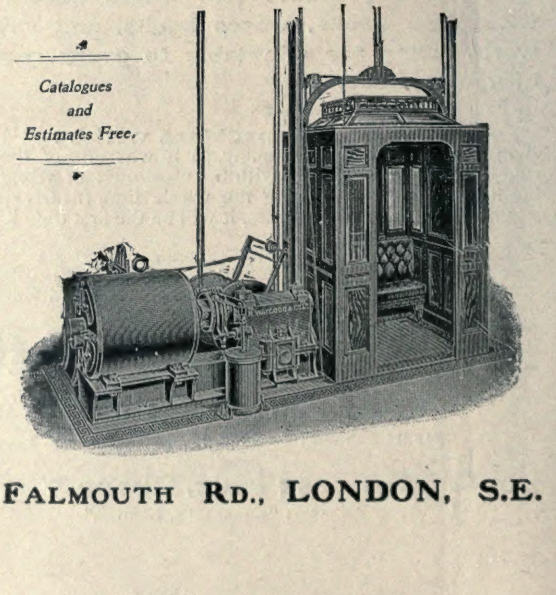

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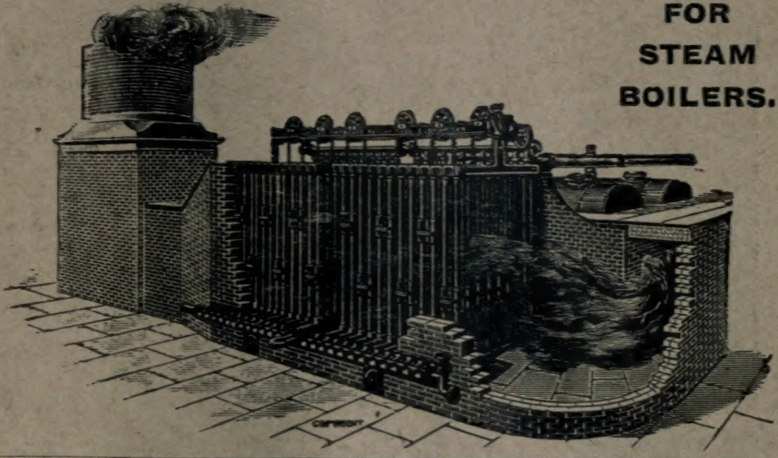

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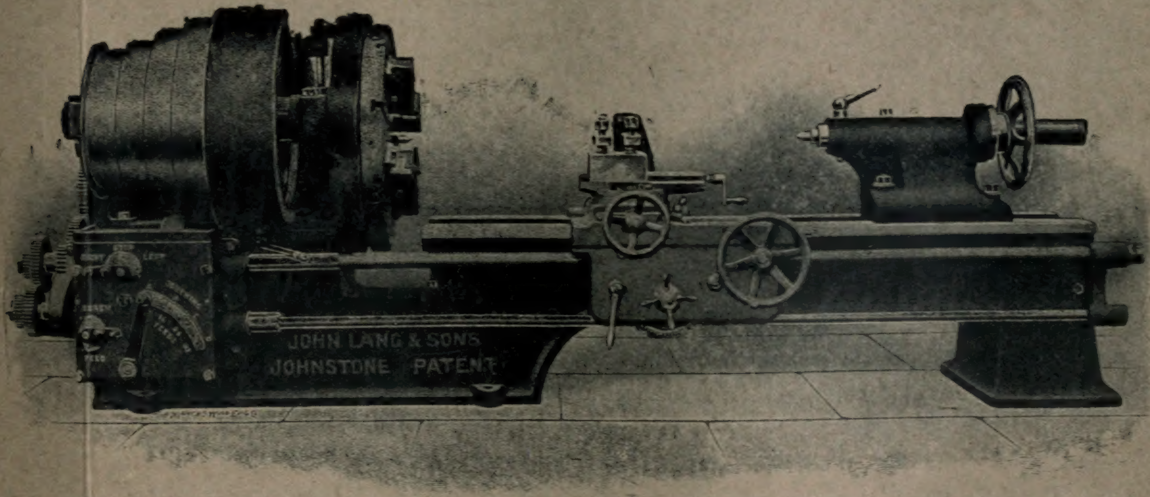

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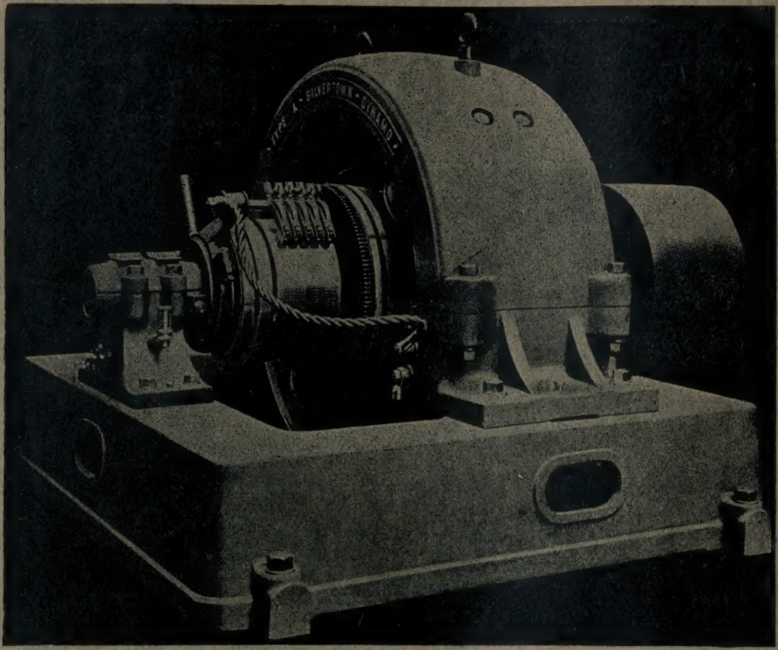

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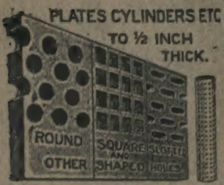

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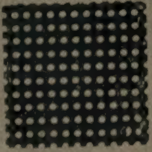

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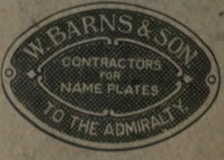

Taper Holes.

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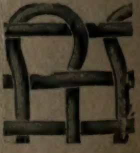

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